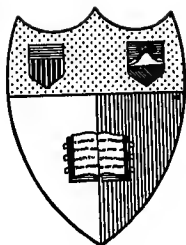


# AGRICULTURE FOR YOUNG FOLKS

A. D. AND E. W.  
WILSON



**New York**  
**State College of Agriculture**  
**At Cornell University**  
**Ithaca, N. Y.**

---

**Library**

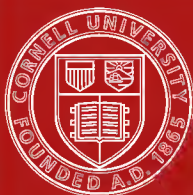
Cornell University Library  
**S 495.W75**

**Agriculture for young folks.**



**3 1924 003 396 938**

maan



## Cornell University Library

The original of this book is in  
the Cornell University Library.

There are no known copyright restrictions in  
the United States on the use of the text.



# AGRICULTURE

FOR

## YOUNG FOLKS

PREPARED ESPECIALLY FOR TEACHING  
ELEMENTARY AGRICULTURE

ILLUSTRATED

---

BY

A. D. WILSON

SUPERINTENDENT OF FARMERS' INSTITUTES AND AGRICULTURAL  
EXTENSION, UNIVERSITY OF MINNESOTA.

AND

E. W. WILSON

FOURTH EDITION  
REVISED



**COPYRIGHT 1910, 1911**  
**By**  
**WEBB PUBLISHING COMPANY**

## PREFACE.

---

This book has been prepared primarily for use in rural schools. No attempt has been made to make it a complete treatise on elementary agriculture. Agriculture must for some time to come be taught in the small one-room rural school. We have felt, however, that it is not advisable to attempt a systematic course in agriculture in such schools, but rather to study the plain problems of the farm and home, as encountered in the daily life of the pupils. These problems must, of necessity, vary in the different localities. A course well suited to one locality may not be suited to another locality, because it does not deal directly with the things with which the pupils are working and with which they are consequently familiar.

The book deals largely with common farm practices, rather than with scientific principles. It is intended to throw some light upon and add interest to the things that are done on the farm from day to day. We feel that if pupils can be interested and enabled to use the farms and the farm homes as laboratories in which to observe and apply the things learned at school, a great step will have been made toward bringing the school in close touch with the home life of the pupils.

A study of agriculture in the rural schools elevates, in the minds of the farm youth, the calling of agriculture. A rather close study of a few farm problems impresses one with the great amount of knowledge and skill required to successfully operate a farm; and must convince one that a farm, rightly managed, affords as much opportunity for development as does a professional or business career.

We do not propose that the topics shall necessarily be taken up in the order presented, but suggest that each teacher begin with that portion of the book dealing with the particular phase of farm work that is being done on the home farms of the pupils at the time the lesson is given.

Each section is a complete reading lesson, followed by questions and examples. Both the questions and the examples relate to the reading lesson. The questions may be answered orally or in the form of a language paper. The examples will show in a forceful way some of the main facts presented in the reading lesson. This manner of presenting the various subjects was chosen so that the study of agriculture might replace a part of the reading, language and arithmetic lessons, and thus allow a study of agriculture without shortening the time of, or crowding out, any other subject.

Many of the complex problems encountered in the management of the farm are discussed here with a view to simplifying them, so that any one may easily understand the principles involved. It may even prove valuable to farm managers, by enabling them to put into practice some of the better methods of soil and live stock management, and to clearly see the aspects of farming as a business.

The idea of preparing these lessons was suggested by Mr. D. A. Wallace, editor of *The Farmer*, and we gratefully acknowledge his suggestions.

We have freely used many of the agricultural books and bulletins in the library at the Minnesota Agricultural College, and have obtained much valuable information therefrom.

Nearly all photographs used were made by Mr. H. D. Ayer, and the drawings were made by Mr. C. H. Welch and Mr. G. F. Krogh.

A. D. WILSON,  
E. W. WILSON,

University Farm, St. Paul, Minn., July, 1910.

# CONTENTS

---

## CHAPTER I.

**Plant Food.**—Sources of Plant Food. Available Plant Food. Seed Requirements. Reasons for Tillage. The Seed Bed. Planting.

## CHAPTER II.

**Tillage.**—Objects of Plowing. Time to Plow. The Art of Plowing. A Plowing Contest.

## CHAPTER III.

**Farm Seeds.**—Good Seed. Selection of Good Seed. Weed Seeds Common in Grain. Weed Seeds Common in Grass and Clover Seed.

## CHAPTER IV.

**Common Weeds and Their Eradication.**—Weeds. Annual Weeds. More Annual Weeds. Eradication of Annual Weeds. Biennial Weeds. Perennial Weeds. More About Perennial Weeds. Eradication of Perennial Weeds.

## CHAPTER V.

**Corn.**—General Features of the Corn Crop. Shapes of Kernels of Corn. Sizes of Kernels of Corn. Parts of a Kernel of Corn. Testing Seed Corn for Germination. Corn Culture. Reasons for the Cultivation of Corn. Methods of Cultivating Corn. Selection of Seed Corn. How to Select Seed Corn. Storing Seed Corn. Methods of Storing Seed Corn.

## CHAPTER VI.

**Potatoes.**—The Potato Crop. Potatoes for Seed and Cooking. Preparations for a Potato Crop. Planting Potatoes.

## CHAPTER VII.

**The Hay Crop.**—Importance of the Hay Crop. Clover. Clover Roots and Bacteria. Curing Hay.

## CHAPTER VIII.

**Farm Management.**—The Standing of the Farmer. Rotation of Crops. Classification of Field Crops. How Plant Food is Made Available. Rotation Maintains Vegetable Matter. Planning Farms. Arrangement of Fields. Practical Rotation. A Five Year Rotation. Farm Accounts. Live Stock Accounts. An Account With a Cow. Marketing Dairy Products. Co-operation in Marketing. Fencing. Building Fences.

## CHAPTER IX.

**Live Stock.**—Care of Live Stock. Shelter for Live Stock. Testing Milk. Testing Cows. Possibilities of the Dairy Cow. Feeding Animals. Composition of Feeds. Feed Requirements of Dairy Cows. To Compound a Ration. Succulent Food for Dairy Cows. Rations Containing Succulent Food. Horse Labor. Feeding Horses. Feeding Horses When Idle. Sheep. Feeding Sheep. Swine. The Brood Sow. Care of Growing Pigs. Fattening Hogs Economically.

## CHAPTER X.

**Poultry.**—Poultry on the Farm. Care of Poultry. Poultry House. One Type of Poultry House. Eggs. Care of Hens in Winter. Feeding Laying Hens.

## CHAPTER XI.

**The Farm Home.**—What a Desirable Home Should Be. Wind Breaks. Sanitation. Sanitation Applied to Household Duties. Ventilation. Physics of Ventilation. A Garden. Plan of Garden.

## CHAPTER XII.

**Fruit on the Farm.**—Value of Fruit in the Diet. Strawberries. Raspberries. Currants and Gooseberries. Apples. Preserving Fruit.

## CHAPTER XIII.

**Country Roads.**—The Road Problem. Systems of Doing Road Work. Road Construction. Maintenance of Roads.

## CHAPTER XIV.

**Co-operation**—Features of Co-operation. Co-operation in Marketing Butter. Marketing Eggs.



# AGRICULTURE FOR YOUNG FOLKS.

---

## CHAPTER I.

### PLANT FOOD.

#### SOURCES OF PLANT FOOD.

**Plant Food in the Air.**—Plants as well as animals must have food; and it is as important to know what plants need and how to supply their needs as it is to know how to properly feed animals.

It may be a surprise to many to know that the greater portion of the plant food comes from the air rather than from the soil. All those substances in a plant called carbohydrates, as starch, sugar and fibrous tissue, are made entirely from carbon dioxide gas and water. The plant takes in carbon dioxide from the air, through its leaves, and water from the soil, through its roots. When the water and the carbon dioxide are brought together in the leaves of the plant, and the sun shines on the leaves, the sun and the green coloring matter (the chlorophyll) in the leaves cause the water and the carbon dioxide to unite. The oxygen and hydrogen in the water unite with the carbon in the carbon dioxide. These three elements form starch. The oxygen in the carbon dioxide is liberated and given off to the air. In this way plants purify the air for animals to breathe and animals exhale air containing carbon dioxide, which furnishes food for plants. Some of the starch formed in a plant is slightly modified during the growth of the plant and forms fibrous tissue and sugar. Examine kernels of wheat and corn and a potato to see what a very large part is starch. The white part of all of them is very largely starch. It is seen from the above that by far the greater portion of our

common plants does not come from the ground as is usually supposed, but is formed from the poisonous gas, carbon dioxide, from the air, and water from the soil.

**Plant Food in the Soil.**—A small portion of every plant comes from the plant food in the soil. A fairly good idea of the proportion of any plant that is taken from the soil is obtained by burning the plant. The ashes remaining represent nearly the whole amount that came from the soil. This portion, though small, is absolutely necessary for plant growth. One may liken the plant food taken from the soil to salt eaten by animals. It furnishes a very small part of the food required, but is absolutely necessary. Hence the importance of having a fertile soil that will furnish these substances as they are needed by the growing crop.

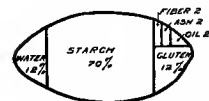


Fig. 1. — A diagram showing the approximate composition of Wheat. The Ash and a small part of the Gluten are composed of minerals taken from the soil. The balance is composed of Carbon Dioxide from the air and water.

Plants are able to get food from the soil only when it is in a soluble form—that is, when the plant food will dissolve in water as sugar dissolves in tea.

**Soluble Plant Food.**—When a soil contains plenty of soluble plant food it is said to be fertile. When plant

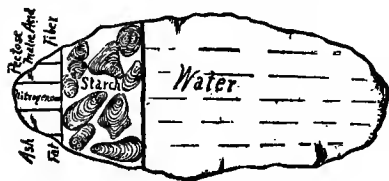


Fig. 2.—A diagram showing the composition of a Potato. From Minnesota Bulletin No. 42.

food becomes soluble in the soil it is dissolved in the soil water. This water containing the plant food, surrounds the fine roots and root hairs of the plant, and passes through their thin walls just as nourishment enters the blood

vessels. In this way plants get their food, soluble organic matter and soluble mineral matter, from the soil. They take in the plant food with large quantities of water. The water is given off from the leaves into the air,

leaving the plant food taken from the soil in the plant. To show plainly that liquid passes up through the stem of a plant and into the leaves, set a branch from a house plant into a bottle of red ink or colored liquid, and watch results. It is seen that large amounts of water are needed by growing plants. Scientists have shown that to produce one pound of dry product, as hay or corn fodder, a plant takes from the soil and gives off to the air from 200 to 500 pounds of water.

Since plants use water from which to make starch and other similar substances, as well as large quantities to take up the other plant food, it is very necessary that they be supplied with sufficient water at all times.

**Soil Moisture.**—There is usually enough rainfall in the Northwest to produce good crops, but it does not always come at the right time; and often, during the growing season, it will not rain for several weeks. Unless land is in good condition to hold moisture, and well cultivated to prevent evaporation from the surface, it may become too dry, and then the plants will not grow well or may die. Farmers can avoid this difficulty largely by keeping vegetable matter in the soil, which holds moisture like a sponge; and by thorough cultivation of the surface, which prevents, to a large extent, the loss of soil water by evaporation. By cultivation the soil is loosened at the surface and the water in the ground cannot rise readily by capillarity, because it is separated from the sun and wind by this layer of loose soil.

It is in such times that the skillful farmer, or the man who knows best how to handle his soil, can get good crops, when farmers who do not know or care, but just "trust to luck," fail.

### Questions:

1. Of what substances are plants largely composed?
2. Tell how these substances are converted into plant tissue.
3. From what source does a plant get a small but essential portion of its food?

**Arithmetic:**

1. How many pounds of wheat are produced on an acre yielding 20 bu.? (A bu. of wheat weighs 60 lbs.)
2. How many pounds of corn are produced on an acre yielding 40 bu.? (A bu. of shelled corn weighs 56 lbs.)
3. How many pounds of potatoes are produced on an acre yielding 150 bu. per acre? (A bu. of potatoes weighs 60 lbs.)

**AVAILABLE PLANT FOOD.**

**Amount of Plant Food.**—Most soils contain enough plant food to grow a great many crops, several hundred perhaps, but this plant food is not present in the soil in a soluble form and it is well it is not. If it were soluble it would be dissolved by the water during a heavy rain, and as the water flowed off over the fields and into the river it would carry with it the plant food, thus leaving the soil unproductive. This may be better understood if one takes two glasses of water, puts a spoonful of sand into one and a spoonful of sugar into the other, and stirs. Then carefully pour the water out of both glasses. The sugar being soluble has been dissolved and will pass out of the glass with the water. The sand is not soluble and will remain in the glass.

Only a very small amount of soluble plant food is needed to grow a crop; but while the amount is small, it is absolutely necessary to have enough of it to supply the plants.

**How Plant Food is Made Soluble.**—There are many different ways of making the insoluble plant food in the soil soluble. These are Nature's ways, and the change takes place naturally in soils under favorable conditions. But farmers can do a great many things to assist Nature in this work.

One very important condition of soil, which favors making plant food soluble, is to keep the soil well supplied

with vegetable matter as it was when the farmer first broke up the virgin sod. Get a small piece of sod from a new piece of breaking, and a handful of soil from an old field that has grown nothing but corn or grain for a great

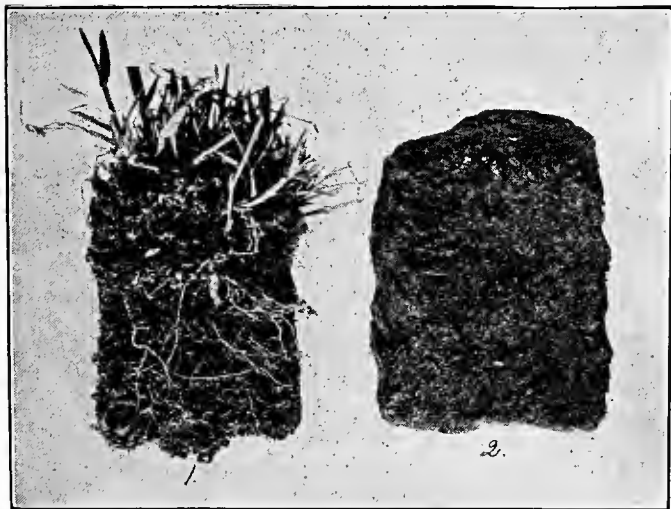


Fig. 3.—(1) A piece of sod showing the grass roots. (2) A lump of dirt taken from a field that has grown corn continuously for fourteen years and which is badly depleted of vegetable matter.

many years. Notice that the first is tough and is held together by many fine roots. The roots are interwoven among the soil grains. The handful of dirt from the old field contains little except the particles of soil.

The plant roots, as well as other parts of plants found in soil, are called vegetable matter. When this vegetable matter is partly decomposed it is called humus.

**Decay of Vegetable Matter.**—When the weather is warm and the soil moist, the vegetable matter in the soil begins to decay. The vegetable matter is composed of plants, and is made up of the things that growing plants

need for food. When the vegetable matter decays the substances of which it is composed are set free or liberated, thus making plant food soluble. The vegetable matter decaying in the soil not only liberates the plant food of which it is composed, but aids very much in making some of the insoluble plant foods in the soil soluble. It also aids by making the soil warmer (all have noticed heat being given off by a decomposing manure pile) and by giving off an acid, called organic acid because it is formed from organic matter. This acid acts on the soil grains and dissolves a small amount of mineral matter off their surfaces.

For the above reasons plant food is made soluble much more rapidly in a soil that contains a good supply of vegetable matter, as new sod land, than in an old soil from which a large part of the vegetable matter has been used.

Many soils that have produced grain and corn a great many years without the addition of manure have become nearly depleted of vegetable matter; and, while they usually contain plenty of plant food, it is in an insoluble form and plants cannot make use of it.

**Adding Vegetable Matter.**—A farmer can add vegetable matter to his soil by growing on it once in every few years such crops as clover, timothy and other grass crops. These crops grow more than one year and consequently have a large root system. These roots add a large supply of vegetable matter; so several crops of corn or grain can be grown successfully following a crop of grass. The application of barnyard manure is another way by which the farmer can put vegetable matter in the soil and thereby increase its producing power.

Examine carefully a newly plowed field that has recently grown a crop of tame grass. If possible note the growth of the crop, from time to time, on such a field, and compare it with the same kind of a crop on an old piece of land that has not been manured for several years.



**Questions:**

1. What do you understand by the term vegetable matter in the soil?
2. In what way does vegetable matter assist in making plant food soluble?
3. In what ways may a farmer best add vegetable matter to the soil?

**Arithmetic:**

1. How many lbs. of water in 20 bu. of wheat?  
(Note: There are 12 lbs. of water in 100 lbs. of wheat).
2. If 70 per cent. of wheat is starch, how many lbs. of starch in 20 bu.?
3. It requires 500 lbs. of water to produce one pound of hay. How much water is required to produce a ton of hay?

**SEED REQUIREMENTS.**

**What Seeds Contain.**—Every seed contains a tiny plant, the embryo, and a comparatively large amount of food material to furnish the embryo with food until it has developed into a plant with roots and leaves and can get its food from the soil and the air. This is explained more fully in chapter V, page 82. In the seeds, as we plant them, the food material is hard and insoluble, and cannot be used by the embryo until it has been made soluble, any more than a growing plant can use the food material in the soil until it has been made soluble.

**Heat, Air and Moisture**, which awaken the embryo, also make the food material soluble for its use. If any one of these three essentials is lacking, seeds cannot germinate; or, if a seed has had heat, air and moisture until it has germinated, and is then deprived of any one of the three essentials, it will not continue to grow, because its food material remains insoluble. All the food material in a seed is not made soluble at once. The process goes on very slowly, but, under favorable conditions, fast enough to furnish the necessary food to the young plant.

**The Need of Heat, Air and Moisture** may be proved by germinating several kernels of corn in a germinator as shown on page 85. When the kernels are well germinated, drop a few of them into a glass of water. Those kernels are supplied with moisture and heat, but are de-

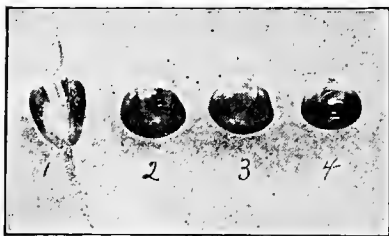


Fig. 4.—Kernels of corn kept for six days under different conditions. 1. Kept between moist cloths in warm room. It had heat, air and moisture. 2. Kept in a glass of water in a warm room. It had heat and moisture but no air. 3. Kept between moist cloths in cold room. Had moisture and air but no heat. 4. Kept on the window sill in a warm room. Had heat and air but no moisture.

prived of air. Put other kernels in a pot of perfectly dry soil or between dry cloths where they will get heat and air but no moisture. Place still other kernels in a refrigerator or some cold place where they will get air and moisture but no heat. Put the remaining kernels into a flower pot filled with loose soil and keep it moist and in a warm place. The air will circulate through the soil so

that the kernels in the pot will have heat, air and moisture. Only these latter kernels will continue to grow. While the seed had heat, air and moisture, only a very small part of its food material was made soluble. Then, as soon as it was deprived of one of the three essentials, the process of making food material soluble ceased and the plant had no food which it could use, hence could not continue to grow.

**Why Seeds do not Germinate.**—The above experiment shows the importance of having heat, air and moisture present in the soil. From a soil that is filled with water or is very hard and packed, air is excluded and seeds cannot germinate or, if an excess of water comes after the seeds have germinated, they cannot continue to grow.

From a soil that is very loose and light and contains no vegetable matter moisture disappears too rapidly and seeds cannot germinate. In the spring we often have several days or a week of cold weather. It will be noticed that seeds do not germinate quickly, or if they have germinated, grow very slowly or not at all while the cold spell lasts.

**Unfavorable Conditions.**—Farmers realize that heat, air and moisture are needed, and as a rule do not plant seed when or where it will not have favorable conditions. You will notice that in low places that are wet and muddy, when seed is sown, the crop does not start to grow so quickly as on higher ground that is just moist. Where land is low, and water stands nearly or quite to the top of the soil, the air is crowded out and seed planted in such a place is deprived of air; hence cannot grow until the place dries out. There is another reason why the seed does not grow so quickly in a low, wet place. It is because the soil is colder in such places. It takes much more heat to warm up a given volume of water than to warm the same volume of soil. You know this from running barefoot on a warm day. Dry sand will burn your feet, while moist sand feels cool. Likewise, you have noticed that corn or grain on a gravelly or sandy knoll does not start to grow quickly if the weather is dry, as such places are very liable to be too dry.

Note places on some farms where crops do not start quickly in the spring, and try to determine the cause. It will very likely be due to a lack of one or more of the conditions mentioned above.

### Questions:

1. In what form is the plant food of a seed when the seed is planted?
2. What change must take place before the plant can use the plant food?
3. What three elements are necessary to this change?

**Arithmetic:**

1. How many acres in a field 40 rods square? (160 sq. rds. in one acre).
2. How many feet wide is a ten-acre field 40 rods long?
3. How many times must one cross a field 40 rods square, with a harrow 12 feet wide, to harrow the field? How far will he travel?

**REASONS FOR TILLAGE.**

**Controlling Conditions.**—A farmer realizes the necessity of heat, air and moisture for his crops; and, while he cannot make the climate warmer or cause rain to fall, he can do many things that help to regulate the heat and the amount of air and moisture in the soil.

Usually the first operation in preparing land for a crop is plowing. Plowing loosens the soil so that air can circulate through it more readily and so that moisture which may fall upon it is more readily taken up. If plowing is done in the fall (which is usually the better time to plow), the loss of moisture by evaporation is checked. The water in the part of the soil turned over by the plow (the furrow slice) is more quickly dried out, but the water in the subsoil (the soil below the furrow) is saved because it cannot rise through the loose furrow to the surface and be evaporated. Fall-plowed land is usually left rough. This rough condition of the surface holds the snow better than a smooth surface would, and rain falling on such a soil settles into it more readily than into unplowed land.

**A Firm Seed Bed.**—It is very necessary that the furrow slice become firmly packed against the subsoil, so that moisture may move up from below into the furrow as oil is raised in a lamp wick. Water is evaporated from the surface of the soil, and moisture must continue to come up from below to supply the needs of plants in the furrow slice. Land plowed in the fall has all winter in which to settle and become packed against the subsoil.

Spring plowing loosens the soil and allows air to circulate through it, and leaves it loose so that rain falling upon it can easily penetrate, but the furrow slice does not have time to settle back against the subsoil, hence a spring plowing is more likely to get too dry as moisture does not rise from below so easily as in a fall plowing.

**Observations.**—Observe two fields, one fall plowed and the other spring plowed. Walk across them and notice how much looser the spring plowed field is than the fall plowed one. Observe also, early in the morning, a field that has been recently harrowed. You will find that the main part of the surface is dry and loose, but



Fig. 5.—Plowing. Note the straight and well turned furrows. Good plowing is the first and most important tillage operation.

that in the footprints of the man who followed the harrow the surface is moist. This is because the surface was packed by the man's weight and the moisture came up from below. In the middle of the day you will

not see this moist surface, because the sun and wind will evaporate the moisture as fast as it comes to the surface.

This shows the necessity of keeping the soil loose on top.

Harrowing not only saves moisture but helps to warm the soil in the spring by checking evaporation. That evaporation of moisture cools the soil is easily demonstrated by wetting one hand, then exposing both hands. The wet one will feel cool at once.

Spring plowing must be thoroughly disked and harrowed to pack it down against the subsoil, and fall plowing must be thoroughly disked and harrowed to loosen the surface soil, thus preventing moisture reaching the surface where it would be evaporated. Harrowing fall plowing helps to warm the soil and to make a good seed bed.

**Ideal Conditions** for a soil on which the common field crops are to be grown are: First, a loose surface soil. Second, a firm, moist, mellow seed bed below the loose surface. Third, a subsoil which contains a considerable amount of moisture that in time of drouth may be passed up to the seed bed to be used by the growing plants.

We often see a piece of land that is hard and baked. Such soil does not afford favorable conditions for growing crops. It is usually a soil made up of small particles called clay. When the weather is wet such land will hold too much moisture and thus have an insufficient amount of air. During a dry spell it bakes and becomes too hard. Such a soil is greatly improved by the addition of vegetable matter; as the vegetable matter separates the particles of soil, thus giving a better circulation of air when the soil is wet, and when the soil becomes dry the vegetable matter gives up the moisture which it holds, thus keeping the soil from getting too dry and baking.

**A light, sandy soil** is liable to become too dry at times. A reasonable supply of vegetable matter in such a soil will greatly overcome this difficulty, as the vegetable matter holds moisture better than the sand. Vegetable matter benefits most of our soils by making them warm-



er. It does this in two ways. First, by giving off heat while decaying. Second, by making the soil darker. A dark soil absorbs more heat and is therefore warmer than a light-colored soil. Proof for this lies in the fact that a light-colored coat is cooler in summer than a black one.

A farmer can make his soil warmer by cultivating it, by draining it and by keeping it supplied with vegetable matter. He can keep air in the soil by cultivation, by drainage and by the application of vegetable matter. He can keep it moist by cultivating, as keeping the surface loose prevents evaporation and allows the rainfall to enter readily, and by keeping a good supply of vegetable matter to retain water.

### Questions:

1. Give some of the advantages of fall plowing over spring plowing.
2. In what ways may a farmer check the loss of moisture from his soil?
3. Of what value is vegetable matter to a light soil?

### Arithmetic:

1. How many square rods in a field 4 rods wide and 40 rods long? How many acres?

2. How many rounds must a farmer make to plow a field 4 rods wide?

(Note: A round means across the field and back. A plow turns a furrow 14 inches wide).

3. How far must a team travel (not counting the turn) to plow one round on a field 40 rods long?

4. How far must they travel to plow one acre?

### THE SEED BED.

**Yields.**—The way in which the seed bed is prepared has much to do with the success of the crop grown. Where farms are large there is a strong tendency to rush through the spring work and get in a large acreage of crops, but often without due preparation of the seed bed. Such hasty work at seeding time is very often the chief cause of a poor harvest.

A great deal of the land now cropped gives such poor yields that very little, if any, profit is left to the farmer. Better preparation of the seed bed is one of the steps in increasing the yields from such land.

A yield of twenty-five bushels of oats per acre leaves the farmer no profit, as it costs as much to raise them as they are worth. A yield of forty bushels per acre leaves considerable margin for profit. Twenty-five acres of oats yielding forty bushels per acre are much more profitable than forty acres yielding twenty-five bushels per acre, as the same amount of oats is raised with less land and labor.

A good seed bed must be moist (not wet), firm enough so it will not dry out quickly, loose enough to permit air to enter the soil, and warm enough to cause the seed to germinate. The farmer cannot regulate the weather, but he can do many things to assist in regulating these conditions, and such is the object of tillage.

**Air is Needed** in the soil to start the seed to germinate and to supply the oxygen necessary in the chemical action which must take place in the soil, to make the plant food in the seed available for the growing plantlet and to break down plant food in the soil on which the plantlet can feed after it has used up the food stored in the seed. Cultivation with a disc or harrow stirs up the soil and lets the air circulate through it.

**Moisture** is needed in the soil—First, to dissolve the plant food in the seed planted, so that the little plantlet can make use of it. Second, to supply the growing plant with water. Third, to assist in the chemical action in the soil which liberates plant food. Fourth, to carry the plant food to the plant. Cultivation of the soil helps to retain moisture, by checking evaporation from the surface by means of the surface mulch and by loosening up the surface soil so any rain that falls will settle into it instead of running off over the surface.

**Need of Heat.**—Seeds will not germinate, neither will plants grow, unless the soil has a certain amount of heat in it. Heat is necessary before the chemical action can

begin. One can not make the weather warmer, but cultivation of the soil, keeping it loose on top so as to check evaporation from the surface, helps to warm up the soil. The circulation of air, promoted by good tillage, is also quite a factor in warming the soil in the spring. The air at the surface of the ground becomes warmed by the sun, and if it can enter the soil it helps to warm that also.

**Methods of Preparing the Seed Bed.**—The best seed bed is formed by plowing land in the fall, so that the portion turned over by the plow will have a chance to settle down upon the soil beneath (the subsoil). Then moisture,



Fig. 6.—Preparing the seed bed by disking.

which is usually present in the subsoil, may move up into the furrow slice by capillary action, as oil rises in a lampwick. This moisture is often necessary to supply growing crops during times when it does not rain for several days. Fall plowing, disced and harrowed to loosen the surface, makes an excellent seed bed. In other words a firm, mellow soil below, covered by two inches of loose, fine soil is the condition desired.

If land must be plowed in the spring, very thorough harrowing is necessary to work the soil up fine and to assist in firming the furrow slice so as to form good capillary connection with the subsoil.

Close observation of fields in the process of preparation for seeding will illustrate forcefully the points mentioned above.

### Questions:

1. What is the principal work of the farmer during April?
2. What are the essential conditions of a good seed bed?
3. Why is air needed in the soil, and how may it be secured?
4. Why is moisture needed in the soil, and how may it be retained?

### Arithmetic:

1. If wheat is worth 70c per bu. and it costs 15c per acre to harrow land, how many times can one afford to harrow an acre of land to increase the yield two bu.?
2. If wheat is worth 70c per bu. and it costs 35c per acre to disc land, how many times can one afford to disc an acre of land to increase the yield 2 bu. per acre?
3. Field A yields 25 bu. of oats, field B yields 40 bu. of oats, how many more dollars' worth of labor can one afford to put on field A than on field B, if oats are worth 35c per bu.?

### PLANTING.

**Time to Plant.**—Crops that are not easily killed by frost, as wheat and oats, are usually the first crops sown. Seeds of these crops will germinate at a comparatively low temperature, as low as from 41 to 50 degrees F. The soil usually reaches this temperature in the spring about as soon as one can begin discing and harrowing, and land that is well disced and harrowed reaches this temperature earlier, as shown in the preceding lesson. It is usually wise to sow these crops as

early as possible and thus avoid the danger from rust, smut and hot winds that are more likely to injure late sown grain crops.

Barley may be sown early, but it is more liable to injury from frost. Experiments show that the best yields are obtained by sowing a week or ten days later than the first seeding of wheat or oats. This is also the most convenient time, as it permits one to sow the other grains first, and then to prepare the barley land. Barley may be sown as late as the last of May if necessary, which is sometimes the case on low, wet land, but earlier sowing is better.

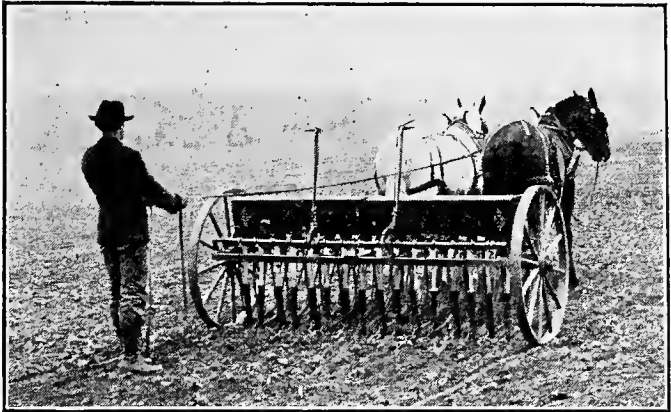


Fig. 7.—Seeding with a drill. The dragging chains cover the seeds, which are placed in the ground at a uniform depth.

**Depth to Plant.**—There are two ways to sow grain. First, by a broadcast seeder, which scatters the seed on top of the ground, where they are covered by cultivating or by harrowing. In this process some seeds are left on the surface uncovered, while others are covered as deep as the land is cultivated. This causes the seeds to germinate unevenly; and, if the land becomes too dry,

much of the seed on the surface will not grow, while if the soil is too wet much of the deeply sown seed will not grow. The better method of sowing is with a drill which deposits all the seed at a uniform depth and at any depth desired. In early seeding one should plant quite shallow, from one to two inches, as the soil is warmer near the surface and the seed and small plants should have all the heat available. On the other hand, seed sown too shallow will not grow well if the weather remains dry for some time, as the surface of the soil dries out too quickly and leaves the plant improperly supplied with moisture. Later in the season when the soil is warmer and plants grow more quickly it is often well to plant the seed a little deeper, from two to three inches, thus giving the plants a better chance to get moisture.

The depth of planting should vary also with the kind of soil. In light, dry soil one should sow deeper than in heavy, wet soil.

**Experiment.**—It is interesting to plant short rows of seeds at different depths and at different times, noting results. Early in spring plant four short rows of oats or wheat. In the first row, plant seeds one inch deep; in the second row, two inches deep; in the third row, three inches deep; and in the fourth row, four inches deep.

Plant an equal number of seeds in each row and note the time required for plants to come up, number of plants that grow and strength of plants. Repeat the experiment later when the soil is warmer.

### Questions:

1. What three conditions must a seed have before it can grow?
2. What can you say of time of planting?
3. What are the advantages and disadvantages of shallow and deep planting?

**Arithmetic:**

1. If the average yield of wheat in the United States is 13.9 bu. per acre, what is the average value of an acre of wheat at 70c per bu?

2. If it costs \$7.89 to produce an acre of wheat, what is the average profit per acre? (See example No. 1).

3. If the average yield of oats in the United States is 32 bu. per acre, what is the value of an average acre of oats at 28c per bu.?

4. If it costs \$8.83 to produce an acre of oats, what is the average profit per acre?

## CHAPTER II.

### TILLAGE.

#### OBJECTS OF PLOWING.

**Plowing not Monotonous.**—Did you ever wonder as you watched men plowing, why they were doing it? Or did you ever think that plowing must be very monotonous work—going forth and back, forth and back, across the field day after day? Plowing is not unpleasant work. In fact, most men like to plow. It is a quiet, peaceful work, and after the rush and anxiety of harvest time, it really seems restful. Plowing is certainly not monotonous work if one knows why he is plowing, and how and when to plow.

**Plowing Mellows the Soil.**—One of the chief reasons for plowing is to stir the soil and make it loose and mellow, so the air can circulate through it, and so the moisture can settle down into it. When the soil has settled all summer and had the heavy rains beating on it, it becomes packed and hard, and must be loosened to prepare it for a new crop.

**Plowing Saves Moisture** for the next crop. When the ground is packed, as it is when the crops are removed in the fall, it is so hard that when it rains much of the water runs off over the surface instead of settling down into the soil. Plowing overcomes this difficulty, and by loosening the surface, any moisture that may be in the subsoil (the soil below the plowed furrow) is retained, because this water cannot readily pass up through the loose plowed soil. If the ground were not plowed the soil moisture would rise clear to the surface, by capillarity, just as oil rises in a lampwick, and when it got near the surface the sun and wind would evaporate it.

**Plowing Destroys Weeds.**—It is natural for all good soils to be producing something at all times during the growing season. As soon as the crop is removed (and



very often before) weeds begin to grow. If nothing is done to prevent it they will go to seed, and thus cause trouble later. Plowing stops their growth. It also turns up new soil to the light, and weed seeds which have been too deep in the soil to grow, are brought near the surface where they can grow. If the plowing is done in the fall these weeds start to grow, but do not have time to produce seed before they are killed by frost.



Fig. 8.—First year clover growing in stubble. Such a crop will furnish better pasture than many cattle are furnished, and is a benefit to the soil. It would be unwise to plow such a field early in the fall, if one has stock that can make use of the feed.

**Plowing Destroys Insects.**—Many insects, such as grasshoppers and cut-worms, are checked by plowing in the fall. The mature insects lay their eggs in the ground in the fall, and if the eggs are not disturbed, they hatch out the next spring, and it is the young from these eggs that do the damage. Fall plowing disturbs the eggs and many of them are destroyed.

**Plowing Helps to Liberate Plant Food.**—We learned in an earlier lesson that plants require food in a soluble form; that is, food in such condition that it will dissolve in water. See page 10. Plowing assists in making portions of the soil soluble, by pulverizing it, breaking up the soil particles, exposing new surfaces, and allowing the sun, wind and water to act on it more freely than such elements can act on unplowed land.

**Plowing Covers Manure and Crop Residue.**—It is generally considered good practice to haul manure directly from the barn to the field before it has rotted, as much of its value is saved in this way. If a rather heavy dressing is applied, it is troublesome in harrowing, sowing and cultivating, unless it is plowed under out of reach of the harrow and other tools, but still where the plant roots can reach it.

It will be interesting to note the effect of plowing, by observing the work as it is being done in some conveniently located field.

### Questions:

1. Explain how plowing saves moisture.
2. In what two ways does plowing destroy weeds?
3. How does plowing destroy insects?
4. How does plowing assist in liberating plant food?

### Arithmetic:

1. A plow turns a furrow 14 inches wide. How many furrows must one plow to plow a strip 7 rods wide?
2. How far will a team travel in plowing with a single 14 in. plow a field 7 rods wide and 40 rods long?
3. How many acres of land in a field 7 rods by 40 rods?

### TIME TO PLOW.

**Condition of Soil.**—The greatest problem that a plowman has to solve, is to determine the proper time to plow. Both the season of the year and the condition of the soil must be considered. If a heavy, clayey soil is plowed when it is too wet, the lumps turned up become hard clods when dry, which it is very difficult to pulverize into a good seed bed. This is especially true if plowing is done in the spring. Plowing clayey land that is wet is not objectionable, however, if done in the fall and the field is not sown until spring, as the thawing and freezing during winter aids in pulverizing any clods that may form. Light sandy or loam soil may be plowed when wet without any serious trouble.

**Time of Year to Plow.**—As a rule early fall plowing is preferable, as it allows the ground to become settled before the crop is sown, thus making it less likely to become too dry during the summer. Early fall plowing also destroys weeds by turning up new seeds, which start to grow in the fall, and are soon killed by frost, while if the same seeds were turned up late in the fall the plants would grow in the spring and trouble the crops. Fall plowing also facilitates spring work, and, by leaving the soil exposed to the elements, aids in liberating plant food.



Fig. 9.—Rape growing in a stubble field. Such a crop may be raised for fall feed at a very small cost per acre. Rape is excellent feed for any kind of stock but milch cows. One might be justified in neglecting to plow such a field early.

**When Not to Plow in Early Fall.**—If some catch crop is growing in the stubble field, as clover, rape or rye, that can be used to advantage for fall pasture, fall plowing—at least early fall plowing—is not always advisable. The green crop and pasturing will prevent largely the growth of weeds, and the green crop checks to some extent the loss of moisture. Thus at least two reasons for early plowing are removed. The green crop,

whether plowed under or pastured off, would add considerable vegetable matter to the soil, which would be of more value to the next crop than would the plant food that would be liberated by the early fall plowing. As the country becomes more thickly settled, and better methods of farming are practiced, farmers will have fewer fields lying idle during the fall. Many farmers now get from 50c to \$4.00 worth of feed per acre from their fields after the main crop has been harvested. This income is almost entirely net profit, and cannot be overlooked as more intensive systems of farming are made necessary by higher priced land.

**Fall Feed.**—On many farms pastures are very poor during the fall and cattle must be fed dry feed or, what more often follows, allowed to get poor or to run down in milk flow. Such conditions are very undesirable, and in most years unnecessary. Clover sown with the grain crop in the spring, or rye sown in the stubble as soon as the grain crop is removed, or rape sown at almost any season of the year, will in ordinary years furnish an abundance of fall pasture. Good fall pasture not only furnishes cheap feed during the fall, but gives stock an excellent start for winter. While the old habit of getting all the land plowed in the fall was an excellent one, and necessary when grain was the only crop, there are now many instances where much better results would be obtained were some of the fields made to produce fall pasture rather than left bare during the fall, in which condition more or less plant food is lost by such exposure. If catch crops are grown on the field so that early fall plowing can not be done, it is better to plow late in the fall than to wait until spring. Most crops do better on fall plowing than on spring plowing. Spring plowing, being loose, is likely to become too dry.

**No Best Time.**—There is no best time to plow. The time must be determined by conditions. It is hoped that those who read this lesson will think about the things mentioned, and observe what the best farmers

in their neighborhoods are doing. They will then be better able to decide intelligently when to plow.

**Questions:**

1. What danger is there in plowing a heavy clay soil when it is wet?
2. What is to be gained by early fall plowing?
3. Give some reasons which may make it advisable to defer plowing until late in the fall.

**Arithmetic:**

1. 4 lbs. of clover seed per acre is sufficient to sow with a grain crop for fall pasture. What is the cost per acre of such pasture if clover seed is worth 15c per pound?
2. If one acre of such pasture furnishes feed for a cow for 20 days, the cow giving  $\frac{3}{4}$  pounds of butter fat per day, how much butter fat is produced per acre? What is it worth at 20c per pound?
3. 3 pounds of rape seed per acre is sufficient to sow with a grain crop for fall pasture. What is the cost per acre of such a crop if rape seed is worth 5c per pound?
4. One acre of such rape will feed 10 sheep for 1 week. They will gain 2 pounds per week each. How many pounds of mutton are produced per acre? What is it worth at 5c per pound?

**THE ART OF PLOWING.**

**Plowing an Art.**—Is plowing tiresome work? This question may be answered in the affirmative by a poor plowman, but never by a good plowman. A plowman who knows how to plow and plows well can always find enjoyment in his work, just as one can who does any kind of work well. A plowman is just as much an artist as is one who paints a picture or carves a statue. To plow a good, straight, even furrow requires skill, application and good judgment. And one who can plow such a furrow as is shown in the illustration, on page 32, can justly feel proud of his ability, and is certainly a credit to his profession.

**The Team.**—To do really good plowing one must have the confidence of his team. A man who is cruel or inhuman with his team, and keeps them afraid of him, cannot do as good work or as much of it as one who is kind and gentle and gives his team a fair chance. A team that is afraid of being jerked or whipped cannot be made to go straight or steady. An expensive, spirited or stylish team is not necessary; but a good plow team should be able to work, have on a comfortable harness, know what is expected of them and be given a fair chance to do it.



Fig. 10.—A good straight furrow plowed by a student in the plowing contest. By plowing back as his team is headed he will have two furrows thrown together which will form a "headland."

**The Plow.**—A plow to do good work must first of all be firm in its joints, with all bolts in place and properly tightened. It should have a good, sharp share, that will cut off rose bushes or other roots instead of slipping past them. All parts that come in contact with the soil must be smooth, hard, polished and kept bright and clean, so the soil will not stick to them. The mouldboard, or part that turns the furrow, must have the proper curve to turn the furrow as desired. If plowing sod, the object is to turn it over evenly without break-

ing it, so a long mouldboard that turns the furrow gradually is used (examine a breaking plow). If plowing

stubble land, the object is to pulverize it or break up the soil into fine particles, so a short mouldboard with a rather sharp turn is needed (examine a stubble plow).

**Condition of Plow.**—A plow in proper condition should run smoothly and at an even depth, with very little effort on the part of the plowman. When a plow does not run smoothly, when the plowman must bear down or lift up on the handles, or must constantly hold the plow either one way or the other to keep it from tipping over, something is wrong with it. The point tips down or up too much, or the cutting edge of the share is dull or slants down or up too much. A good plowman must know how a good plow should work, and when it does not work right should know what is wrong with it. To know these things requires as much thought and study and mental and mechanical ability as to understand a telephone or a telegraph instrument.

**The Field.**—Sometimes farmers plow a field by starting at the outside each year and plowing around and around until the field is plowed. Such a method throws dirt to the outside each year and gradually builds up a high ridge. (Examine some of the fields in your neighborhood and you will probably find such conditions.) This gives a very slovenly appearance to the field, and makes trouble in using the harvester and other machines. A far better way is to plow the field in lands. A field is said to be plowed in lands when it is plowed in narrow strips, so that every furrow reaches clear across the field. The team goes without plowing across the end.

**To Plow in Lands** a furrow is plowed directly across the field and parallel with one side. The team is turned to the right, at the end, and a furrow plowed back across the field, thus throwing the two furrows together. This is called a back furrow or headland. The plowman continues plowing about this headland until the plowed strip is as wide as he desires. The usual width is about four rods. The plowman then measures off

at right angles to the plowed strip, six rods, and plows another furrow parallel to the first furrow. At the end he turns to the right, thus forming a new "headland." He plows about this until it is as wide as the first, or four rods. Two of the four rods is plowed off of the six rods measured off and two of the four rods is outside of the six rods. Thus he has two plowed strips each four rods wide with an unplowed strip between them also four rods wide. He then turns his team to the left and plows the four rod strip remaining, plowing from the outside toward the center. The last two furrows are thus thrown apart, leaving a ditch called a "dead furrow." The next time the field is plowed "Headlands" are made in the old "dead furrows" and "dead furrows" are made in the old "headlands."

### Questions:

1. What makes plowing, or any other work, interesting?
2. How does the treatment of a plowman's team affect the work?
3. Name some of the requirements of a good plow.
4. Why is it not wise to always plow a field by plowing around and around it?

### Arithmetic:

1. If a man with two horses can plow two acres in eight hours, what is the cost per acre to plow when a man's time is worth 14c per hour and each horse's time is worth 8c per hour?
2. If a man with 4 horses can plow four acres in eight hours, what is the cost per acre to plow, with man and horse labor at the same rate as given in example No. 1?
3. If one can plow 10 days in August, 15 days in September, and 10 days in October, how much can he plow during the fall, with two horses, plowing 2 acres per day? With 4 horses plowing 4 acres per day?



## A PLOWING CONTEST.

**A Novel Contest.**—Many may never have heard of a plowing contest. Such contests are very common in Canada, but in the United States most people feel that they are too busy to take part in such a thing. Plowing affords a most excellent field for a contest, and gives a better opportunity for all to compete than does a horse race or a football game. In a horse race only those who have money to buy the best horses can win, and in football only those who are endowed with a strong physique can make really first-class players. In a plowing contest any one with a fairly good farm team stands an equal chance with the rest, if he uses the skill which he may acquire and applies himself diligently to the task. Every competitor in a plowing contest is sure to win if he really tries. He may not win the prize, but he is sure to gain skill and knowledge which will make him a better plowman, a better farmer, and consequently a better citizen.

**Plan of Contest.**—One of the best contests ever held among the students at the Minnesota School of Agriculture was a plowing contest. There were three classes in the contest, Freshmen, Juniors and Seniors. Each class chose by trial three of its best plowmen. So there were nine young men contesting. Each was given a team, a walking plow and required to "strike out" two headlands twenty feet apart and plow out the land between. Three contestants, one from each of the three classes, worked at the same time, thus keeping up the class interest. It took the three about an hour to finish, then three more began.

**Requirements of Contest.**—Some plowmen seem to think the main thing in plowing is to make the field look black, but in this contest this was forgotten. Each contestant knew that to win he must plow a straight furrow of even depth and width, and turn it squarely over so as to cover all stubble and weeds. He knew that the two headlands must be so straight that they

would be as far apart at one place as at another and the every furrow must be kept straight clear across the field so that when the land was finished the last furrow would be full width and extend the entire length of the field as shown in Fig. 11. Each contestant took great pain to start in squarely and evenly at the ends and to drive straight out at the ends, for he knew that his work was to be judged on every point.



Fig. 11.—Finishing the land. Lands must be carefully started and furrows kept straight to finish as shown here. When this last furrow is plowed a dead furrow will be formed.

**The Prizes.**—The first prize offered was a sulky plow, the second prize was \$10.00 worth of pedigreed seeds, and the third prize was \$5.00 worth of nursery stock.

Each contestant had his mind set on the sulky plow and was determined to win it. In this spirit the boys went at it with heart and mind and skill and determination, and they all won. That is, they plowed their best, and the poorest plowing done would be a credit to any farm and an inspiration to any farmer who saw it.

**Spirit of Contest.**—It required all the skill of the plowman and the patience of his team to keep the plow in place. Could he do it? Surely he must, for dozens were watching him and hoping that he should. Slowly the team moved across the field; and it was with a sigh of relief that the spectators saw the last foot of the last furrow turn over in place. It was with a feeling of just pride in a worthy task well done that each plowman viewed his completed work.

**To Judge Plowing.**—Good plowing means straight furrows of uniform depth and width, no wider than the plow can cut, and turned squarely over so as to cover all weeds and stubble. It means starting squarely at the ends, and driving out straight at the ends, and plowing out just so far each time, so the end of the plowing is left square and even. A man who can do such plowing will never find plowing drudgery, and may always be proud of his profession.

**Questions:**

1. What can you say regarding the skill required to do good plowing?
2. What do you consider to be good plowing?
3. Compare a plowing contest with a football game and with a horse race.

**Arithmetic:**

1. If a man is plowing a square 40-acre field in lands, how many four-rod lands will there be?
2. In plowing a 40-acre field in lands, how many furrows will there be? How many rounds?
3. How long will the lands be on the square 40-acre field? How many acres will there be in each land four rods wide?

## CHAPTER III.

### FARM SEEDS.

#### GOOD SEED.

**Like Produces Like.**—Careful study of a handful of grain as it is threshed will show that not all of the kernels are alike. Some will be small, some large, some shrunken, and some plump.

It is as important to have good kernels of grain from which to raise a crop as to have good horses, sheep or cows from which to raise colts, lambs or calves. One of the laws of Nature which we must consider in raising plants and animals is that "Like produces like." If we want to raise large horses we must have large horses from which to raise them. If we want to raise dairy cows we must keep dairy cows or cows which have the ability to produce large amounts of milk. Likewise, if we wish to produce good plants we must sow good seed.

**Test of Good Seed.**—Good seed of any kind of grain must have at least three qualities:

First—It must be pure, that is, free from weed and other grain seed.

Second—It must be well matured, plump and heavy.

Third—It must germinate well so as to produce strong plants.

You will notice by examining a small sample of grain (place a small sample on a piece of white paper) that there is a great difference in the size, character and shape of the kernels. (Separate the sample into good and poor lots). Would you care to plant the poor seed? You might be interested to plant ten of the very best, large, heavy seeds and ten of the poorest, small, light seeds in a box of pure sand. Moisten the sand and keep the box in a warm room. See which seeds produce the larger, stronger plants.

**Parts of a Seed.**—A seed is made up of three parts. See page 82. First, a small plantlet or germ, the

embryo, inside of each kernel which will, when the seed is placed under favorable conditions as to heat, air and moisture, grow and produce a plant. Second, the food material stored about the embryo, to feed it until it has developed a root system so as to be able to get food from the soil. Third, the seed coat on the outside for protection.

It is evident that a large, plump kernel or seed will have a stronger, larger germ than will a small or shrunk-en seed, and will also have more food for the little plant-let, so the plantlet will get a better start before it must obtain its food from the soil.

**Select Seed from Best Plants.**—Another reason for selecting the large, plump seeds is because it is reasonable to expect that they grew on good, strong, healthy plants. There are a great many unfavorable conditions with which plants have to contend, such as diseases like

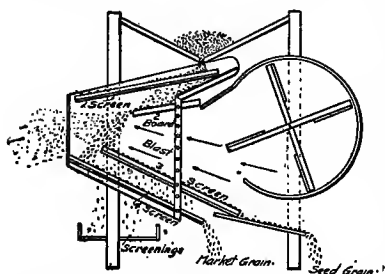


Fig. 12.—Diagram of a Fanning Mill, showing a good method of grading seed grain. The wind blast blows the lighter kernels over the end of screen No. 3, and they go in with the market grain. The heavy kernels fall on this screen. The smaller of these go through the screen into market grain, leaving only the heavy large kernels to go into the seed grain.

smut, rust and blight; unfavorable weather conditions, as cold or wet or drought or heat; also poor soil conditions. It is evident that some plants are better able to withstand such conditions than are others. Those that do withstand such unfavorable conditions, and are best adapted to the soil and climate, will be likely to do better and produce better and more perfect seed than will other plants. The heav-

iest and plumpest seeds are selected when seeds from the best and most vigorous plants are secured. Hence when one selects for seed the heavy, plump seeds raised on his

farm, he not only gets good, strong seed, but he gets seed that is adapted to his soil and climate.

Heavy seed grown in some other part of the country is usually heavy because it grew under favorable conditions rather than because it came from especially strong plants. For this reason the heaviest seed grown on your farm is often better seed to sow than still heavier seed from some other locality.

### Questions:

1. What law of Nature must be considered in raising plants and animals?
2. What are the three qualities that all good seed must possess?
3. What two kinds of seed can you usually find if you examine a good, pure sample of grain?
4. What are the three parts of a seed, and the purpose of each part?
5. Why is a heavy, plump seed better than a small or shrunken one?

### Arithmetic:

1. Land at the Minnesota Experiment Station, seeded with heavy, plump seed oats, yielded 9.5 bu. per acre more than similar land seeded to light weight oats. What was the additional income per acre from heavy weight seed if oats are worth 40 cents per bu.?

2. If 2 bushels of heavy seed oats (sown on one acre) give an increased yield of 9.5 bushels, what will be the increased yield from one bushel of heavy weight seed oats?

3. If one bushel of heavy weight seed oats gives a yield of 4.5 bushels more than is secured from a bushel of light seed, what is the value of one bushel of heavy weight seed when oats are worth 40 cents per bushel?

Note: If the light weight seed is worth 40 cents per bushel, the heavy graded seed will be worth 40 cents plus 4.5 times 40 cents.

## SELECTION OF GOOD SEED.

**Pure Seed.**—It is well worth while for farmers to raise only pure varieties of grain, or grain that contains no other kind or variety of grain. Seed of Blue Stem wheat should be free from oats, rye, and barley as well as from other kinds of wheat. Pure seed grain may be secured by purchasing a small amount of pure seed and using care in growing it so it will not become mixed; or, if one prefers to start with the seed on the farm, he may go through a small patch when it is headed out in the field and pick out and destroy the other kinds of grain, thus getting a small patch pure, from which a start in pure seed may be made.

As a rule the very best seed that one can get for the main crop on his farm is from grain that has been grown on the farm for several years and that has given good yields. Such grain when graded and cleaned, so only the very best is saved for seed, usually gives him excellent seed.

The two general principles by which grain can be graded, separated or cleaned of weed seeds, by the use of the fanning mill, are by size and shape of kernels or by weight.

**To Remove Weed Seeds.**—Most weed seeds may be removed from grain by running the grain through a fanning mill. The large weed seeds are separated from the grain by the grain dropping through a sieve that is too fine to let the weed seeds through. The small weed seeds are taken out by running the grain over a sieve that is too fine to let the grain through but coarse enough to let the small weed seeds through. The weed seeds that are lighter than the grain may be blown out. Sometimes the light grains, like oats, may be separated from heavy weed seeds by blowing the grain out of the weed seeds.

There are some weed seeds, like cockle and wild vetch, which are about the same size and weight as wheat, that are very hard to separate from that grain. While such

weed seeds as wild oats are very hard to separate from oats and barley, as the seeds are quite similar in character. When such weed seeds are present in grain and can not be removed with a fanning mill, a small amount of seed free from such weed seeds may be secured by hand picking or by pulling the weed plants from a small plat of growing grain, thereby getting a start in clean seed.

**Grading Seed Grain.**—Many people are satisfied when they get pure and clean seed grain; but, if one wishes to get the best results and maintain or improve his grain from year to year, it is necessary to grade out and use for seed only the very best individual seeds in the whole amount grown on the farm. This may be cheaply done by grading the grain as shown on page 39. In this way the heavy, plump kernels are separated from the smaller, lighter ones. The former kernels should be used for seed and the latter sold or used for feed.

**Germination.**—It is as important that seed grain germinates (starts to grow) well as that seed corn germinates well. It is a

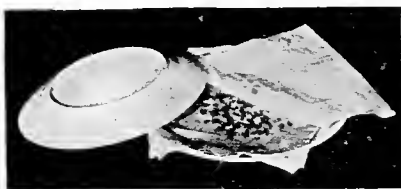


Fig. 13.—A simple germinator for testing seed grain. The lower plate is partly filled with sand, the grain placed between the cloths on top of the sand and all covered by an inverted plate. If kept moist and in a warm room, good seed will germinate in from 5 to 7 days.

very simple matter to test seed grain for germination, and this should always be done before it is planted. A good germinator is made as follows: Partly fill a plate with sawdust or sand, cover with a cloth, and on this scatter one hundred seeds. Cover with another cloth,

moisten, and cover all with an inverted plate. See Fig. 13. Good seed in such a germinator, kept moist and in a warm room, as a living room or school house, for from five to seven days, will sprout. The number out of the one hundred



that start to grow vigorously in that length of time will represent the percent of the seed that will be likely to grow in the field. It will pay to try this with several different kinds of grain.

**Questions:**

1. From what source is one most likely to get good seed grain for most of his planting? Why?

2. In what ways may weed seeds be separated from seed grain?

3. By what method can one cheaply separate the large, plump kernels of grain from the small and light kernels?

**Arithmetic:**

1. Two men can clean and grade with a fanning mill 20 bu. of grain in an hour. If the best 30 per cent is saved for seed, how many bushels of seed will be secured? How much will it cost per bu. to save seed in this manner if each man's time is worth 15c per hour?

2. If it costs 5 cts. per bu. to grade out the best seed and it requires two bushels of seed to seed an acre, how much must the yield be increased per acre to pay for the extra cost of grading the seed if oats are worth 40 cts. per bu.?

3. If one seeds 50 acres to grain that germinates but 80 per cent, how many acres are seeded to grain that will not grow?

**WEED SEEDS COMMON IN GRAIN.**

**Loss Caused By Weeds.**—When a farmer sows a field of grain he hopes to secure a large harvest. He may not stop to think, but it is nevertheless true, that every weed which grows in his field helps to decrease his yield. Weeds injure a crop by using the plant food and moisture in the soil which should go to produce the desired crop; by shading the smaller grain plants and crowding them out; by increasing the cost of harvesting the grain through the increase in the amount of twine need-

ed and the amount of labor required to shock, stack and thresh the crop; and by depositing their seeds in the grain, thereby increasing the cost of marketing the product and at the same time reducing its market value.

**Clean Seed Grain.**—However careful a farmer may be and has been for several years, some weeds are bound to spring up and grow from roots or from seeds

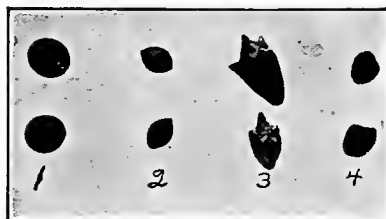


Fig. 14.—Seeds of (1) Wild Pea or Vetch; (2) Wild Buckwheat; (3) Ragweed or Kinghead; (4) Corn Cockle.

which have lain dormant in the soil for a year, or perhaps longer, until recent plowing or harrowing has placed them where they can grow. But many farmers increase the amount of weeds in their fields, and often introduce new and bad varieties by buying or using seed grain that con-

tains these weed seeds. The weeds in each year's crop may be lessened noticeably by sowing only grain free of weed seeds.

Farmers should be able to recognize the weed seeds found in grain, so that they may not buy and use seed grain that contains seeds of dangerous weeds.

**Description.**—Below is given a brief description of five kinds of weed seeds most commonly found in grain:

**Corn Cockle or Blue Cockle.**—A rough, black, somewhat triangular seed, about as large and heavy as a kernel of wheat. It is common in seed wheat as it is hard to separate these seeds from the grain. See Fig. 14.

**Ragweed or Kinghead.**—A dark brown heavy seed. The seeds vary in size from slightly smaller to considerably larger than a kernel of wheat. They are easily recognized by the crown-like appearance of the tip. The seed is smaller at the base, with several ribs extending lengthwise and terminating in as many points around a

central point in the tip, giving it the crown-like appearance mentioned. It is common in grain in the Red River Valley. See Fig. 14.



Fig. 15.—Seeds of (1) Wild Oats; (2) Tame Oats.

**Wild Oats** may be distinguished from common white oats by the following points: Wild oats are darker in color, are more slender, have a small tuft of hair at the base and have a long, crooked awn. This awn is not always a safe guide, as it is often broken off in the threshing machine. It is very com-

mon in grain throughout the state. See Fig. 15.

**Wild Buckwheat** is a black, three-sided seed. Often found covered with a brown husk. It is nearly the size of a kernel of wheat, and common in grain grown on old fields. See Fig. 14.

**Wild Pea or Vetch.**—A heavy, dark brown or gray seed, round in shape and about the size of, or a little larger than, a kernel of wheat. It closely resembles in shape the common garden pea, and is easily split in halves the same as a pea or a bean. It is quite common in grain. See Fig. 14.

Much more will be learned about the above weeds if samples of grain are examined and specimens of weed seeds of each variety discussed are found and studied.

### Questions:

1. In what four ways do weeds injure field crops?
2. Tell at least two ways in which weeds get into fields.
3. Describe each weed seed we have studied.

### Arithmetic:

1. If a farmer sows a 50 acre field of grain with seed containing 3% weed seed, how much land will he sow to

weeds? How much will he lose if his grain yields \$15.00 worth of product per acre?

2. If 10 per cent of the crop in a field is weeds, and it requires 4 lbs. of twine per acre, costing 15 cents per pound, to bind the crop, how much does it cost per acre for twine to tie up the weeds?

3. A farmer has 1,000 bu. of oats threshed; 4 lbs. in each bu. is weed seed. What per cent of his crop is weeds? How many pounds of weed seed has he?

#### WEED SEEDS COMMON IN GRASS AND CLOVER SEED.

**Pure Seed.**—Sowing grass and clover seed that is not pure is one of the most common ways of getting bad weeds into the land.

Grass seeds are so small that many weed seeds may be mixed with them and not be noticed unless one is perfectly familiar with both the grass seeds and the more common weed seeds.

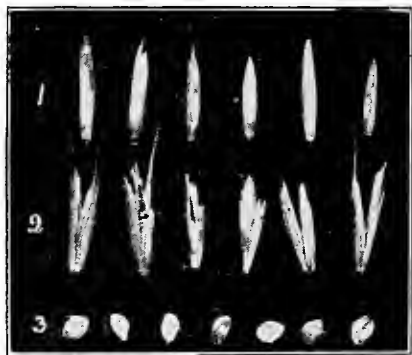


Fig. 16.—Seeds of (1) Quack Grass, single; (2) Quack Grass with two or more seeds as they grew. They were not separated when shelled. They often appear together in this manner. (3) Pigeon Grass.

Where there is a good stand of grass or clover there is very little chance for weeds to grow. In a poor stand—perhaps the result of sowing poor seed, or of sowing on poor soil, or of winter killing—weeds are very likely to spring up and make a good growth and their seed to be mixed with

the grass seed at harvest time.

**Hay a Cleaning Crop.**—If a grass crop is cut for hay, the weeds growing in it are, as a rule, cut before they

have had time to ripen seeds. For this reason the hay crop is considered a cleaning crop.

Hay with weeds in it is very inferior in quality, and every effort should be made to get such a good stand of grass as to prevent weeds from growing with it. The first step in getting a good stand of grass is to sow good clean seed that will grow. If the grass seed we sow contains weed seeds, we not only sow the undesirable weed seeds, but also sow less grass seed, hence get a poorer stand.

**Description.**—Below is given a brief description of four kinds of weed seeds most common in grass seed:

**Pigeon Grass** is about one-fourth as large as a grain of wheat. It varies in color from nearly light yellow to light green, and has one flat surface. In shape it is similar to half a bean. It is common in grain and in grass seed.

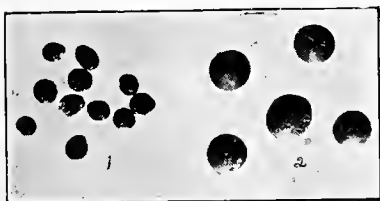


Fig. 17.—Seeds of (1) Pigweed; (2) Wild Mustard enlarged.

**Mustard** seeds are smaller than a pinhead, almost perfectly round, and dark brown to nearly black in color. They resemble rutabaga seeds and are easily identified by tasting, as they have a sharp, spiey taste. Mustard seed is common

both in grain and in grass seed. See Fig. 17.

**Pigweed.**—The seeds of pigweed are small, shiny and black. They are half the size and about the shape of a common pin head. They are commonly found in grain and in grass seed. (See Fig. 17.)

**Quack Grass.**—Seeds are slender, light in weight, somewhat the shape of oats, but only about one-half as long. They are green or light yellow in color. Some-

times two or more seeds are joined together. They may be found in grain or in grass seed, especially in bromus. Quack grass seed is a little heavier, smoother, and more yellowish in color than bromus seed.

We suggest that our readers examine carefully several samples of grass seed found in the neighborhood. First to become familiar with common grass seeds; as red and alsike clover, timothy, alfalfa, and bromus; and also to learn to identify the weed seeds mentioned above, and to readily observe and know them when seen in a sample of grass seed.

### Questions:

1. What is a very common way of getting weeds on a farm?
2. Why is it easier to get bad weed seeds in grass seed than in seed grain?
3. For what reason is a hay crop considered a cleaning crop?

### Arithmetic:

1. A bushel of timothy seed weighs 45 lbs. What is it worth at 5c. per lb.?
2. A bushel of clover seed weighs 60 lbs. What is it worth at 15c. per lb.?
3. There are 32 quarts in a bushel. Clover seed weighs 60 lbs. per bushel. What does one quart weigh? Timothy seed weighs 45 lbs. per bushel. What does one quart weigh?
4. If a farmer seeded 10 acres of land with grass seed containing 10 per cent. weed seeds, how much land would he sow to weeds?

## CHAPTER IV.

### COMMON WEEDS AND THEIR ERADICATION.

#### WEEDS.

**A Weed** is any plant out of place. For example, rye growing in a wheat field or any grain plant growing in a corn field is as much a weed as is pigeon grass. But we commonly think of weeds as undesirable plants that are found in our fields, meadows and pastures, such as mustard, thistle, etc.

**Weeds are Harmful** in many ways. As we have learned in the previous lesson, they use moisture and plant food that are needed by the useful crops. They shade or crowd out other plants. They greatly increase the cost of growing crops. They increase the cost of harvesting, by requiring more twine and by making more bulk to handle. They decrease the quality of grain and increase materially the cost of marketing.

There is no accurate way of estimating the loss caused by weeds, but it is very great. Weeds cost many times as much as do all of the schools in the country.

One of the great problems of farming is the control of weeds, and no farmer can make much of a success of his business until he learns how to effectively fight weeds.

**Weeds Get Into Fields** in a great many different ways. Some weed seeds remain in the soil for several years, and still retain sufficient vitality to grow when given favorable opportunity. Weed seeds are carried into fields by water, by wind, by birds, by animals, by machinery, or sometimes in the seed grain or in the grass seed.

There are no very easy ways of controlling weeds, but the first essential of success is to know the common weeds and their habits. Then one may discover the measures necessary for their eradication.

There are not a great many different weeds that are very troublesome, and it is not a difficult matter to become so familiar with most of the common ones as to rec-

ognize them when seen, either as seeds or as young or mature plants.

**Specimens.**—It may prove an interesting and profitable pastime, at the proper season of the year, to gather specimens of all the weeds that you commonly find in your fields, to observe them carefully and try to find some characteristic by which you can identify each kind. You may desire to press, mount and name these specimens.



Fig. 18.—Yellow Mustard, showing tap root, hairy stem and (1) the seed pod split open; (2) the blossom, showing arrangement of the 4 petals in the form of a cross, from which this family of plants gets its name—Cruciferae; (3) Seeds.

**Mounting Weeds.**—Select two or three plants that represent their class, and dig them up in such a way as to show the root, the leaves, the stem, and if possible the blossoms. Lay or hang them in the shade until well wilted but not dry. Then spread out the parts carefully, to show each plainly. Lay the plants between a couple of sheets of blotting paper, if you have them; if not, put the plants between newspapers, and put heavy weights on



them. Change the papers often until the plants are dry, to prevent them from moulding. When dry, mount them on a piece of white paper by pasting over the stem and branches, and upon the paper at several places, little strips of paper, with mucilage or paste on one side. Plants carefully mounted will be of great value for use in identifying weeds later.

**Value of Collection.**—Handling plants so thoroughly and carefully, as is necessary to gather and mount them, makes one quite familiar with them. You may be sure your teacher would appreciate such a collection of weeds for use in the school room, especially if they are named. If you do not know the name of some weed, and cannot find out in your neighborhood, get as near a perfect specimen of the plant as you can (being sure to get the roots, stem, leaves and if possible the flowers or head) and send it to your State Experiment Station, and it will be named for you. If you have ever studied botany or ever expect to, you will find your work with weeds of great value.

It is hoped that every reader will examine carefully the weeds commonly found in his locality, until he can recognize them all at sight.

**Classes of Weeds.**—If the habits of weeds are studied it will be found that all weeds may be placed under the three classes, Annuals—those that live but one year—Biennials—those that live two years—and Perennials—those that live from year to year.

**Questions:**

1. What is a weed?
2. What do we commonly think of as weeds?
3. How are weeds harmful?
4. How great is the loss caused by weeds?

**Arithmetic:**

1. If a field of wheat yielding 18 bu. per acre were injured 10 per cent. by weeds, how much would it have yielded had it been free of weeds?

2. If a boy can pull the mustard in an acre of grain in two days, what does the mustard cost the farmer if the boy's time is worth 60 cts. per day?

3. If a man spends an hour cleaning enough seed grain for two acres, how much will it cost him per acre if his time is worth 14 cts. per hour?

#### ANNUAL WEEDS.

**Definition.**—Annual weeds are those that produce seeds in one year and die. In this class we find such common weeds as pigeon grass, lambs' quarter, wild oats, wild barley, mustard, corn cockle, wild buckwheat, cockle burr, French weed, rag weed, etc.

**Pigeon Grass or Foxtail.**—Of all the weeds pigeon grass is probably the most common. It is an annual and readily recognized by every one. It is very troublesome, especially on poor soil where crops do not make heavy growths. It is very likely to grow up quite thickly and produce a great deal of seed in the corn field after cultivation has ceased. It is well to plant some other crop, as rape, grain or clover, just before the last cultivation of corn. This seed, covered by the cultivator, will make quite a rapid growth in the corn and help to hold back the pigeon grass and other weeds.

**Mustard.**—Yellow or black mustard is an annual weed very common in grain fields. It is readily recognized by the yellow blossoms with four petals (the yellow part of the mustard blossom), as most flowers have more than four petals, or it may be recognized by its round black seed.

There are several kinds of mustard, but the variety mentioned is by far the most common. Thousands of acres of grain fields are yellow with mustard in June.

Mustard is hard to get rid of, as the seed may live for five or more years in the soil and still grow when brought near enough to the surface. The plants have the ability to send out branches that produce seed, and if the main stem is cut off by the mower or binder these side branches grow out quickly and produce seed. On this account, if a grain field is infested with mustard it is very hard to prevent mustard seed from being formed and left in the

soil, for if the plants do not succeed in ripening seed before the grain is cut (they usually do, however), these lateral branches will produce enough seed after the grain is cut to badly infest the soil.

**Spraying Weeds.**—Mustard may be destroyed in grain fields, without injury to the grain, by spraying with a 3 per cent solution of copper sulphate or with a 20 per cent solution of iron sulphate. Iron sulphate is the cheaper chemical and is more commonly used. It is a by-product in the manufacture of wire, and can be purchased at from \$12.00 to \$20.00 per ton. It usually comes in 100-lb. sacks.

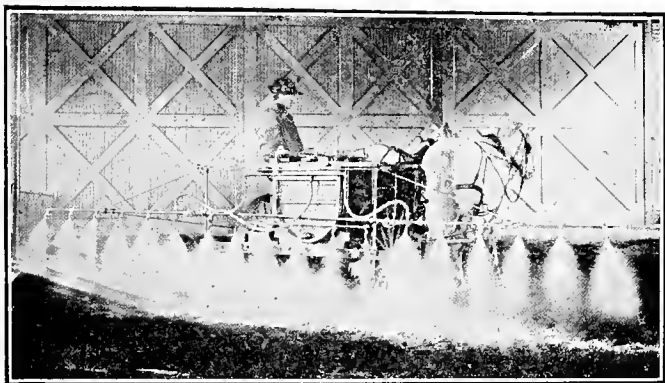


Fig. 19.—A large 20-foot spraying machine with 160-gallon tank, showing the misty, fog-like spray that is essential to best results in spraying.

100 lbs. of iron sulphate dissolved in a barrel (50 gal.) of water make a 20 per cent solution, and the 50 gallons are sufficient to spray one acre. Mustard should be sprayed before it forms pods. The smaller the plants, the easier they are killed.

**Spraying Machines** are offered for sale at from \$60 to \$150. They will spray a strip of land from 16 ft. to 24 ft. wide. They have a tank holding from 50 to 240 gallons of water, mounted on two wheels, and a force

pump run by the traction of the wheels. Sufficient pressure must be obtained to force the solution through fine nozzles, to make a misty, fog-like spray that settles on the leaves without falling to the ground. Large fields badly infested with mustard have been sprayed and 90 to 95 per cent of the mustard destroyed, at a cost of 60 cents to 75 cents per acre for material and 15 cents to 25 cents per acre for labor. French-weed and rag-weed were injured by this treatment, but not enough to prevent them from seeding. Canada thistles were injured, but grew up from the roots again. Sow thistles, wild oats and quack grass are uninjured by this treatment.

The above treatment is very helpful in controlling mustard on grain farms, but on diversified farms mustard is more cheaply and effectively destroyed by a proper rotation of crops.

### Questions:

1. What do you understand by the term Annual weeds?
2. Describe yellow mustard and tell what you know about it.
3. Tell what you can about destroying mustard by spraying.

### Arithmetic:

1. What is the cost of 100 lbs. of iron sulphate at \$15.00 per ton?
2. How many pounds of water in 50 gal.? A gal. of water weighs approximately 8 pounds.
3. If 100 lbs. of sulphate of iron is added to 50 gal. of water, what proportion is sulphate of iron? What per cent?
4. If a team travels 12 miles in a day with a machine spraying a strip 16 ft. wide, how much will they spray in a day? What will be the cost per acre for labor if the man, team and machine are worth \$5.00 per day?

## MORE ANNUAL WEEDS.

**Wild Oats.**—Probably one of the most troublesome of the annual weeds is wild oats. It is common in most grain-growing sections. It is easily distinguished from tame oats, when growing, by the spreading panicle or head, and when ripe, by the seeds, which have long awns and a tuft of fine hair at the base of each. Examine carefully a plant of wild oats, comparing it with tame oats until you have no difficulty in telling one from the other.

Wild oats ripens earlier than do most of the grain crops, and the seeds shell off upon the ground before the grain is cut. In this way seed is left in the ground from year to year. The seed may live in the ground from two to four years and still grow. So if wild oats gets a start in a field it is practically impossible to get it out if grain is grown year after year.

**To Eradicate Wild Oats** raise corn occasionally, so that the wild oats will be killed by cultivation, and seed the land to grass for a year or so every three to six years. The hay crop is cut early in the season before the wild oats ripen, then again later in the season before a second crop of the oats can ripen, thus preventing them from seeding. If a field is left two years in grass, then planted to corn and well cultivated, it should be comparatively free from wild oats. Care should always be taken to sow seed free from wild oats. With a good fanning mill wild oats can be cleaned out of wheat or flax quite thoroughly, but it is quite hard to separate them from oats and barley; and, if the farm is badly infested with wild oats and an attempt is being made to clean it, it will be well to get seed barley and oats from a clean farm rather than to depend on cleaning seed that has wild oats in it.

**Wild Barley**, or squirrel tail, is also a very common and extremely troublesome annual weed. It is a fine grass-like plant and usually grows in bunches along road sides, in old meadows and pastures, and in any sod land

where a heavy growth of other grasses is not found. It does not grow so high as tame barley or wheat, and is easily recognized by the soft drooping heads with exceedingly long awns or beards. Handle a plant of wild barley and compare it carefully with tame barley and with pigeon grass.



Fig. 20.—Wild Barley or Squirrel Tail. Notice the soft, fine stem and soft, drooping heads with long awns.

The plants head very early in the season (in May or early in June) and ripen seeds very early. It is such a soft plant and leans over so much that it is very hard to mow it close enough to the ground to get all the heads. Hence it is practically impossible to mow it close enough, either with a scythe or mower, to prevent its seeding. It is not, as a rule, common in cultivated fields, as in grain or corn, but is very troublesome in old meadows and pastures. In meadows it is undesirable, as it is fully ripe by the time the hay is cut; and later, when the hay is fed, the awns of the wild barley work into the mouths of cattle and horses and often cause sores.

**To Eradicate Wild Barley,** meadows and pastures should be broken up and planted to corn or grain for two or three years, then reseeded. If such places cannot be broken up, an effort should be made to prevent, as far as possible, the wild barley from seeding. Then try to thicken up the stand of desirable grasses by loosening the soil with a harrow, top dressing it and sowing in such grass seeds as clover, blue grass or bromus. If a good

stand of these grasses can be secured they will crowd out the wild barley.

**Wild Buckwheat** or bind weed is likewise a very common weed. It starts very early in the spring and where it is thick it practically chokes out the grain crop. It is a twining plant, as shown in the cut, and when it twines about grain plants they have a poor chance to grow. It is not generally troublesome except in grain fields. Hunt up some of these plants and examine them until you are sure you know them or any part of them. Find a morning glory vine and compare it with the wild buckwheat. (See Fig. 21.)

**To Eradicate.**—The weed is quite easily killed out of a field by growing cultivated crops, as corn, and cultivating thoroughly; by growing grass crops, which give the buckwheat very little chance to grow and no chance to seed, and by using clean seed. The seeds of buckwheat are nearly as large as kernels of wheat, and it is quite difficult to separate them from seed grain, but it can be done by a good fanning mill well operated.

### Questions:

1. How can one tell wild oats from tame oats?
2. Why does the hay crop check wild oats?
3. Where are the most likely places for wild barley to grow?
4. How may one exterminate wild barley?
5. How does wild buckwheat injure a grain plant?

### Arithmetic:

1. If a farmer raises 38 acres of wheat which yields  $18\frac{1}{2}$  bu. per acre, and is docked 5 pounds per bu. for weed seeds, how many pounds is he docked? How much would this dockage be worth at 70c per bu. if pure wheat?
2. Because of weeds, 1 pound more twine at 11c per pound, is required to tie up an acre of wheat, 1 hour more labor worth 14c is required to shock and stack it. The yield is reduced 2 bu. per acre on account of weeds. What is the loss per acre? Per 100 acres? Wheat is worth 70c per bu.

## ERADICATION OF ANNUAL WEEDS.

**Clean Seed.**—Too much care cannot be taken in cleaning any seed grain. It is often the opinion that just a few weed seeds can do no harm, but weeds in a grain field are nearly as bad as wolves in a flock of sheep. With a good fanning mill practically all of the weed seeds can be cleaned out of seed grain. If there are weed seeds in your grain that cannot be cleaned out do not use it. Get seed that is clean.

**Keep Weeds off the Farm.**—Sometimes threshing machines that have been used on farms badly infested with weeds may carry weeds onto the next farm. This difficulty can be overcome by insisting that the threshing machine be thoroughly cleaned before it is allowed to move from a weedy farm onto yours. If feed containing such weed seeds as wild oats and mustard is fed to work horses without grinding there is danger of getting weeds onto the farm, as some of these seeds may pass through the digestive tract of a horse and be uninjured. Thus they may get into a field in the droppings from the horse.

Hauling straw or hay from a weedy farm is likewise dangerous, and many bad weeds are often obtained in that way. Running water may also carry weed seeds onto the farm. This can hardly be prevented, but if the water is made to run in ditches instead of spreading out over a large surface, weeds that may come are much . . . more easily controlled.

**Prevent Weeds From Seeding.**—Annual plants live but one year, so if one can keep them from seeding he can soon have his field clean, as the seeds in the soil will either germinate and be killed or spoil in the ground in a very few years. To prevent weeds seeding is more easily said than done. Yet diligent effort and a good plan of attack usually bring success. There are a great many ways of attacking weeds, and a few of them will be briefly mentioned below.

**A Good Rotation of Crops** affords the very best remedy for controlling annual weeds. Rotation of crops means



the changing of the grain crops and meadow and pasture crops and the cultivated crops, so that each kind of crop is grown on each field one or more times in three to seven or eight years. The meadows and pastures destroy weeds because the crops are cut or fed off before the weeds have a chance to seed, and the grass is usually



Fig. 21.—Wild Buckwheat or Black Bind Weed. Notice the root, leaves, seed and twining stem.

so thick that the weeds have but little chance to grow in it. This is not true if pastures or meadows are left in one place for a long time, as the stand of grass is likely to get thin in places and give the weeds a chance. It is usually unprofitable to leave fields in meadow or pasture for more than three years at a time. Cultivated crops in a rotation are very beneficial in destroying weeds. Weed seeds will not grow unless they have the right conditions, that is, have heat, air and moisture. If they are buried too deep they may lack either heat

or air, and if too near the surface they may be too dry. Frequent cultivation of the soil not only kills the weeds that have started to grow, but also covers up weed seeds that are too near the surface to germinate and turns up others that are too deep, so it gets more seeds where they will grow and be killed by the next cultivation. Watch a field after it has been cultivated, and observe what weeds grow from seeds that have been placed by cultivation so they could germinate.

**Pasture Stubble Fields.**—Pasturing stubble fields is a good way to destroy some of the annual weeds. Sheep are especially good animals for this work, as they will eat many kinds of weeds and eat them so close to the ground that they cannot seed. If rape, turnips or clover is sown with the grain crop in the spring a large amount of good feed may be furnished in the fall in the stubble field, and if this is pastured off many weeds will be destroyed. Observe sheep and cattle and see what weeds they eat and what ones they leave.

**Disc Stubble Fields.**—If there is no crop growing in the stubble field, as rape or clover, and it is not handy to pasture it, a great many weeds and weed seeds may be destroyed by disking the field soon after harvest. The disc will kill some weeds that would otherwise go to seed, and it covers a great many weed seeds so they will start to grow and the young plants will be killed later by plowing or by frost.

**Use Quick Growing Crops.**—Barley, millet and other quick growing and thick growing crops are useful in fighting weeds. They may be sown late in the season, which gives a chance to cultivate the soil a few times before the crop is sown. These crops grow rapidly and thickly, so they give weeds a poor chance. They also ripen early, so very few weeds can ripen and shell their seeds before the crop is harvested. Being removed from the field early, the field can be disced, plowed or pastured to further destroy weeds.

**Weed Seeds Grow in the Fall.**—Some people have believed that weed seeds, especially wild oats that have been produced during the summer, will not grow in the fall; but they will grow if given a chance. Try this by gathering in the fall a few ripe seeds of some of the weeds mentioned above, and planting them not later than Sept. 1. Cover them one-half inch deep, and if the soil is dry moisten it and watch results.

**Questions:**

1. Give three things necessary to do to keep a farm free of weeds.
2. In what ways does a rotation of crops aid in eradicating weeds?
3. In what ways do quick growing crops aid in eradicating weeds?

**Arithmetic:**

1. A man with four horses can harrow 40 acres in 8 hours. How much can he harrow in 1 hour?
2. A man's time is worth 14c per hour and each horse's time is worth 8c per hour. What does it cost per day for the labor of a man and 4 horses (10 hours for working day)?
3. If a man and 4 horses harrow 40 acres per day, what does it cost the farmer per acre to harrow his land? (Is not harrowing a cheap way to kill weeds?)

**BIENNIAL WEEDS.**

**Definition.**—Biennial weeds are those that grow from seed one year, live over winter, mature, seed the second year, then die. There are but two of our common weeds, Bull Thistle and Burdock, that belong to this class.

**Bull Thistle.**—Every country boy or girl readily recognizes the common thistles. They are tall, coarse plants with hollow stems. Their leaves are curly and have sharp spines at the tips and about their margins. The blossoms or flowers are very small, but grow in large, compact heads 1 in. to 1½ in. across. The heads are purple or lavender, and on bright days bees are usually seen flying about these flowers after the honey they contain. Many may be interested in examining a thistle head or cluster of blossoms. Tear it apart carefully and notice the great number of slender, tubelike flowers of which it is composed. The head that is commonly called the flower is a cluster of flowers. Then get a ripe head, pull it apart and notice that at the base of each flower is a seed nearly the size of a kernel of wheat. About all that is now left of the flowers is some long;

white hairs attached to the top of each seed. When a ripe head is broken open these hairs spread apart, and if the wind is blowing the seeds may be carried a long distance. This is the way nature has provided for distributing the seeds.

The Bull Thistle is quite common in all parts of the country. It is usually found in pastures, waste places and along roadsides, but is not troublesome in cultivated fields.

**Thistles Compared.**—There are several kinds of thistles; but if one makes a mistake in naming them there is no serious harm done, as all are very much alike in habit with the exception of the Canadian Thistle and Sow or Milk Thistle, which are both perennials and very bad weeds.

The Sow Thistle is easily told from the other thistles by its smooth leaves and yellow blossoms. The Canada Thistle is not so easily distinguished from the common thistle. Every boy and girl should know the Canada Thistle, so if any of them get on the farm they can be destroyed before they get a start. The Canada Thistles are smaller in all parts—head, stem and leaves—than the Bull Thistle. They are more certainly distinguished by their underground root stalks that connect several plants, while the Bull Thistles have tap roots and each plant is separate. Try to find specimens of each and notice the difference in leaf, head, root and manner of growth.

**Burdock**, the other common biennial weed, like the Bull Thistle, is found in pastures, waste places and along roadsides, and is also not troublesome in cultivated fields. It is a coarse, bushy, branching plant with broad leaves. It is sometimes confused with the Cockle Bur, which resembles it very much. But the Cockle Bur is an annual and is sometimes found in cultivated fields. The two weeds are most easily distinguished by the burs. The bur of the Burdock is more nearly round than is that of the other and has several angular seeds in it, each of which is supplied with a tuft of hair at the upper end by which it may be blown about. There are

many little spines on the surface of the Burdock bur, which enable it to cling to the clothing or to the hair or wool of animals. In this way also the seed is distributed. The bur is easily torn apart. The bur of the Cockle Bur is about twice as long as it is broad and has two hook-like projections at the top. It is quite hard to open, but when opened reveals two cells with one seed in each. If the two can be found examine them closely so you will be able to tell them apart.



Fig. 22. — Burdock. (Note coarse leaves and rounded burs with spines.) Compare with fig. 23.



Fig. 23.—Cockle Bur. (Note coarse leaves, oblong burs with two hooks at top.)

**To Eradicate Biennials** prevent them from seeding. This may be done to some extent by mowing, but where possible a better way is to cut them off just below the ground with a spade or similar instrument. Then branches can not start out from the stub and produce seed. They are very ugly looking weeds and should never be allowed to seed, as one plant will produce many seeds and they may be blown or carried a long distance. If

old pastures can be broken up and sown to grain or corn, and new fields seeded for pasture, these weeds will give very little trouble. In stony or rough pastures that cannot be plowed, these weeds should be kept cut off and an attempt made to get a good stand of bromus or blue grass which would crowd them out.

### Questions:

1. What can you say of a Bull Thistle—its leaves, flowers and roots?
2. How are seeds of the Bull Thistle distributed?
3. How would you tell a Bull Thistle from a Canada Thistle? From a Sow or Milk Thistle?
4. How can you distinguish Burdock from Cockle Bur?
5. How is Burdock seed distributed?

### Arithmetic:

1. If a man's time is worth 14c per hour and each horse's time is worth 8c an hour, what does it cost per acre to keep the thistles out of a 20-acre pasture if it takes a man and team 13 hours to mow the same? What is the cost per acre?
2. If a man spends 15 hours each month for three months to keep the burdocks cut off in a six-acre field, what is the total cost at 14c per hour? What is the cost per acre?

### PERENNIAL WEEDS.

**Perennial Weeds** are perhaps not the most common weeds, but they are certainly the most persistent and troublesome. To this class belong such weeds as Quack Grass, Canada Thistle, Sow Thistle, Morning Glory, and Curled Dock. These weeds grow not only from seeds, but persist in growing and spreading even if prevented from seeding. They grow from underground root stalks and when the land is plowed, instead of the root stalks being killed they are broken up and dragged about. From the joints in these pieces will come new plants. These root stalks grow out from the new plants also,

and in time plants start along the new root stalk. Where there is one plant in the spring there may be several in the fall.

Every farmer should be thoroughly familiar with these weeds so as to recognize them at once and exterminate them as soon as they appear. It is a very serious matter to get a field badly infested with these weeds as it requires much labor and expense to eradicate them.

**Curled Dock** is a perennial weed that grows from underground root stalks. It is a plant about two feet high and has long narrow leaves. Its seeds are three sided, with a wing-like attachment on each of the three edges. It may prove interesting to gather some of these seeds and notice the winged arrangement by which they may be blown about. You may have seen them drifting along on the top of the snow. On the plant the seeds are clustered along the top end of the stem and branches. Curled dock is commonly found in low, moist places. It is not considered a very bad weed, but may give considerable trouble on poorly drained soils. Good drainage, good cultivation and rotation of crops are the most satisfactory ways of handling this weed.

**Morning Glory** is easily recognized by its large white, pink or purple funnel shaped blossoms. They are very pretty, but are not desirable in fields, as they are hard to get rid of. They twine about the crop plants and choke them out. They spread by very tough, string-like underground root stalks, and any ordinary system of rotation or cultivation will not kill them out. Persistent hoeing, so as to keep all the leaves cut off, not allowing any to appear above ground for a whole season will kill them. This is very hard to accomplish. They may also be destroyed by thorough bare fallowing.

**Sow Thistle**, the smooth leaved, yellow blossomed thistle, is also a perennial and a very persistent and troublesome weed. In some sections it is getting such a start that it threatens to take possession of whole fields unless heroic efforts are made to eradicate it. It produces seeds which are blown about; and these greatly as-

sist in spreading it, though it may easily spread all over a farm simply by means of its root stalks. It would be well if every farmer and every farm boy and girl could get hold of a specimen of this plant and study it until thoroughly familiar with it and able to identify one at sight.

**Canada Thistle**, as stated, is somewhat similar to the common or Bull Thistle, though smaller in every respect. It is not nearly so common as is the Bull Thistle, but where it is found it is a much worse weed. Practically every thing said of the habits of the Sow Thistle is true of this thistle.



Fig. 24.—Bull Thistle. (Note head, spiny leaves and seed with large, hair-like tuft at top, which enables it to float in the air.) Compare with Fig. 25.



Fig. 25.—Canada Thistle. (Note that the plants are attached by underground roots.) Compare with Fig. 24.

The Canada Thistle has been destroyed by mowing off just when in bloom. The stems are hollow, and rain running down through the hollow stem has caused the roots to decay. Such results are not frequent, though, as there are usually young plants just starting that are



not hurt by the treatment, and they keep the field infested. This thistle is injured to some extent by spraying with sulphate of iron, but this is not thought to be a thoroughly reliable treatment. See page 71.

**Questions:**

1. What is a perennial weed?
2. Name some of the differences between Canada Thistles and Sow Thistles.
3. Tell all you can about curled dock.

**Arithmetic:**

1. Morning glories twine about and destroy 200 hills of corn on an acre. What part of the crop is thus destroyed? (There are 3240 hills per acre.)
2. If this acre of corn yields 45 bu., how much would it have yielded had not the 200 hills been destroyed?
3. A man raises 48 acres of corn. 200 hills out of each acre are destroyed by weeds. How many acres are destroyed by weeds?
4. What is the value of 3 acres of corn yielding 48 bu. per acre when corn is worth 35c per bu.?

**MORE ABOUT PERENNIAL WEEDS.**

**Quack Grass** is a perennial, grass-like plant and spreads by seed and by underground root stalks. (See Fig. 29.) When it once gets a start, and especially in good soil, it grows in very thick masses and crowds out every kind of cultivated plant. The underground roots grow so thick as to form a very tough sod, difficult to plow and pulverize. If such a soil is plowed, pulverized and seeded, the small pieces of quack grass roots grow and form such a thick mass that whatever crop is planted is very liable to be crowded out

**Root Stalks.**—The underground root stalks are jointed about every inch, and from every joint left in the soil new plants will grow, the same as a potato plant will grow from a potato eye or as a willow cutting will grow. If you are not already familiar with the way quack grass grows and spreads, it might be of interest to dig

up a bunch of the plants and observe them. You will see that several plants are attached by white root stalks, that the root stalks have sharp points that enable them to push their way through the soil, and that these underground root stalks are jointed.

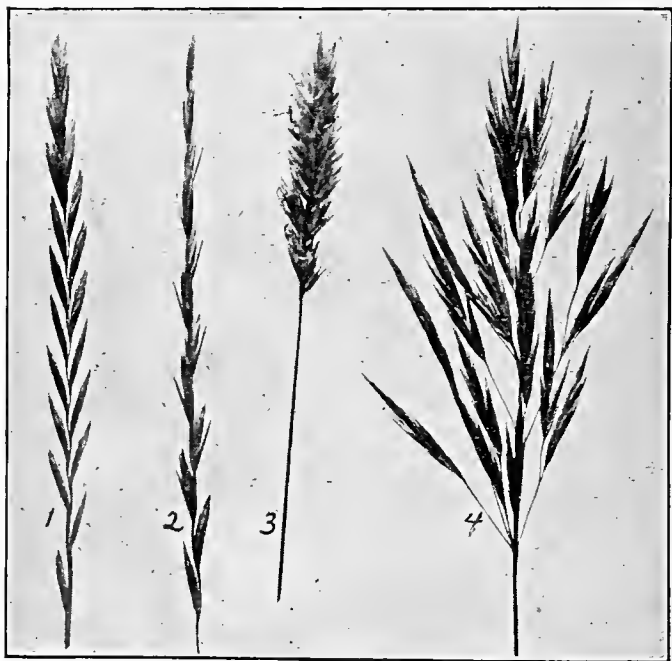


Fig. 26.—Heads of (1) quack grass; notice how much closer the spikelets are than in (2) rye grass; (3) true sweet vernal; (4) bromus.

**Quack Grass Compared with Other Grasses.**—Every farmer and farm boy and girl should be able to recognize quack grass when he sees it. This is quite easily done if one knows its habits of growth and just takes the pains to notice the difference between it and a few other grasses that are somewhat similar but sufficiently

different to be readily recognized if one has but compared them.

To one who is familiar with the plant it is usually recognizable by its general appearance, and especially by its habit of growing in thick bunches; but for those who are not so familiar with it there are two ways, at least, by which it may be recognized. These are by the heads and by the underground root stalks, or by both. If one has both the head and the root he can be practically sure of identifying it.

**Rye Grass** has a head somewhat similar to quack (see Fig. 26) but the two may usually be identified by the fact that the spikelets on the head of the rye grass are farther apart than on the head of the quack grass. Each spikelet on the quack grass extends past the base of the

spikelet next higher on the same side of the head while in rye grass each spikelet does not reach the base of the spikelet above it. (See Fig. 26.) Rye grass is a plant rather commonly used for a hay crop, especially in the west, where the seasons are usually dry. It does not make as good a quality of hay as does timothy or bromus. It is not hard to destroy, as it has no root stalks, and may be distinguished from quack grass by the fact that its roots are fine and fibrous, similar to timothy roots.

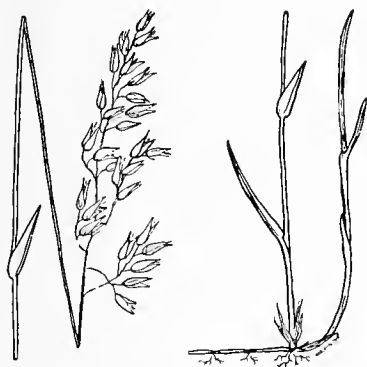


Fig. 27.—Root and head of holy grass commonly called sweet vernal because sweet scented and often mistaken for quack grass in the spring before heading, as it has root stalks.

**Sweet Vernal.**—Another grass commonly called sweet vernal, though not truly sweet vernal (Fig. 27), is very often mistaken for quack grass, as it has similar under-

ground root stalks. This grass is usually recognized by its sweet, spicy odor, and is certainly distinguished from quack grass by its bushy, panicked head, so different from the straight spike of the quack grass.

**Bromus**, a cultivated grass quite commonly grown for hay or for pasturage, may sometimes be mistaken for quack grass, especially when small. *Bromus* is rather persistent, and after a meadow or pasture of *bromus* is plowed it often starts in thick bunches, in the spring, very similar to quack grass and the two are not easily told apart at this stage, as both have underground root stalks. *Bromus* may be recognized, however, by its broader leaf, and when heads appear, by its broadly spreading panicle. See Fig. 26.

**Muhlenbergia**.—Another class of plants, known as *muhlenbergia*, is sometimes mistaken for quack grass, but plants of this class may be told with reasonable accuracy by their scaly root stalks. The heads also are sufficiently different to identify them. See Fig. 28.

It is hoped that every reader will carefully examine a quack grass plant and compare it with as many of the other plants mentioned in this section as possible, or at least, compare it with the illustrations. This we believe will help him to recognize the pest with reasonable accuracy. If our readers will gather specimens (roots, head and all) of three or four of these grasses and study them carefully it will aid them greatly in identifying quack grass.

### Questions:

1. How does quack grass grow in good soil?
2. Why is it hard to plow a quack grass sod?
3. From what points in quack grass roots do new plants grow?
4. Compare a head of quack grass with a head of rye grass; with a head of sweet vernal; with a head of *bromus*; with a head of *muhlenbergia*; and show differences by sketches.

**Arithmetic:**

1. If quack grass reduces the yield of corn 10 bu. per acre, what is the loss per acre when corn is worth 35 cts. per bu.?
2. If quack grass causes a loss of \$2.00 an acre per year, how many years would it take to lose \$9.00 or the approximate cost of eradicating it?
3. If quack grass crowds out 32 square rods of grain on each acre, what per cent of the crop is destroyed?

**ERADICATION OF PERENNIAL WEEDS.**

**The Problem.**—One of the very serious problems with which farmers have to contend is the eradication of perennial weeds, and the very hardest of these to control is quack grass. Perennial weeds are so persistent that ordinary methods of cultivation instead of killing them only cultivate them and increase their growth. Simply keeping these weeds mowed down and preventing them from seeding is not sufficient to kill them. The roots must be removed or destroyed or the plants will persist in growing.

When there is but a small patch, or at most only a few small patches, of these perennial weeds, some of the following methods of eradication may be successfully followed:

**Remove the Roots.**—The roots may be dug from a small patch by spading the ground with a manure or potato fork and carefully shaking out all the roots. These should be taken from the field and burned if possible, or at least put where they cannot grow. The patch must be watched carefully for a season or two and any new plants that appear must be removed. It is not easy to get all the roots the first time.

**Smother with Tar Paper.**—The roots of any plant are dependent upon its leaves for nourishment. While the roots take food from the soil, the food is of no use to the plant until it has first been to the leaves, where it is changed to a form in which the plant can use it. If, then, the leaves can be kept away from the sunshine the

roots will starve and decay. Covering with tar paper will accomplish this, and it is a practical method for small patches. The paper must be left on from six to eight weeks, and should extend three or four feet beyond the edges of the weed patch.

**Smother with Straw or Manure.**—Small patches of these weeds may be killed out by covering with straw or manure. The covering must be put on very thick, three or four feet deep, and should extend three or four feet farther than the edges of the weed patch.



Fig. 28.—Roots and head, of one of the muhlenbergias. The roots of all muhlenbergias are similar. Note scaly root stalk.

The above methods are effective, but when a whole field is infested with any of these weeds it would be too expensive to cover it or to dig out the roots by hand.

**Easy Methods not Effective.**—There are many ways suggested of eradicating these weeds, and most of them have considerable merit. Plowing late in the fall and exposing the roots to thawing and freezing of winter

has been suggested. This undoubtedly injures the roots, but we have never known of a case where it killed them out completely. Another remedy suggested is to plow the land late in the spring and seed to some thick growing crop, as hemp or buckwheat. These crops injure the weeds considerably; but in most cases the weeds are only checked and in a year or so the field is as badly infested

as ever. While these methods are comparatively cheap they are so seldom effective that, as a general thing, they are more expensive than the more costly and surer methods suggested below.

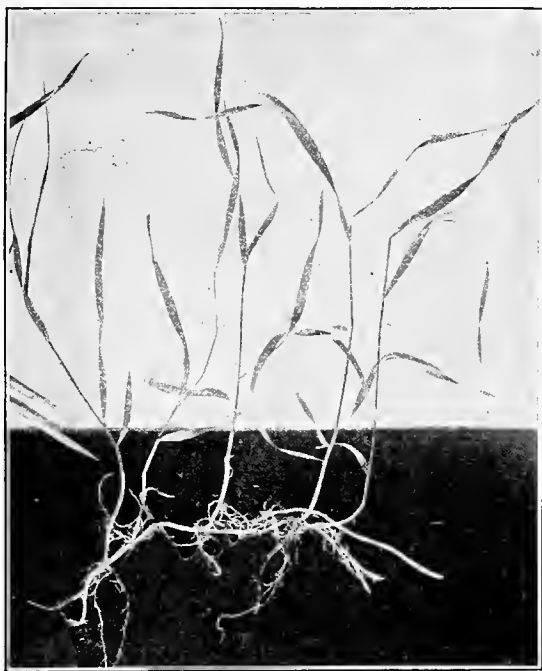


Fig. 29.—Roots and stems of quack grass. Note jointed root stalks and that several plants are attached.

**Bare Fallowing.**—Quack grass and other perennial weeds have been completely eradicated by thorough bare fallowing; that is, so thoroughly cultivating the soil that the plants are prevented from forming any leaves. This is based on the same principle as covering with tar paper or manure (the theory of smothering the plant) but

may be applied to large fields. The plan is to set aside a field and not attempt to raise a crop on it. Allow the weeds to grow in the spring until they begin to head. At this time the roots are the weakest they will be, as they have expended a part of their energy to produce seed. At this stage plow under the whole crop deeply and completely. This will be done early in June, and from that time until fall nothing should be allowed to grow on this field. The disc should be run over the field every few days, to cover any leaves that may appear. If the leaves are not allowed to appear above ground the roots must die. The year following the bare fallow the field should be planted to corn, so that any plant that may have escaped will be seen and may be destroyed.

The above method is costly, but is much cheaper than to farm with these weeds in the field all the time.

**Other Methods.**—If quack grass fields can be pastured two or three years the roots will come closer to the surface; then deep plowing in the middle of the summer will turn the roots under so deeply that it is easy by frequent discing to keep them from growing. This cheapens somewhat the process, because the land can be pastured part of the season.

Some farmers have been successful by keeping the field thoroughly cultivated and bare until the middle of the summer and then sowing some quick and thick growing crop, as hemp, millet or buckwheat, to thoroughly shade the ground. Thorough fallowing the entire year is the safer practice. If a field is free of these weeds, care should be taken not to carry the roots on the harrow, plow or cultivator from infested fields.

### Questions:

1. What measures must be taken to eradicate perennial weeds?
2. In what way does tar paper destroy quack grass?
3. What is accomplished by thorough bare fallowing?



**Arithmetic:**

1. If a roll of tar paper containing 500 sq. ft. costs \$1.25, how much will it cost for paper to cover one sq. rod of quack grass? To cover an acre?

2. If a man can dig 1 sq. rod of quack grass in 4 hours, what does it cost per sq. rod? What is the cost per acre? (Note: A man's time is worth 14c per hour.)

3. To thoroughly bare fallow a field, it must be plowed once and disced 15 to 30 times. What will it cost to plow an acre once and disc it 25 times? (Note: It costs \$1.25 per acre to plow, and 35c per acre to disc.)

## CHAPTER V.

### CORN.

#### GENERAL FEATURES OF THE CORN CROP.

**Yield of Corn.**—Average yields of corn in even the best corn growing states of the union are very low, much lower in fact than yields secured by the best farmers. Corn is one of the staple crops, and it is well worth the time of any one interested in farming to know the methods practiced by the best farmers, that they may secure maximum yields at the least possible expense of labor and fertility.

As farmers change from grain raising to a more diversified type of agriculture, more live stock will be kept and more corn raised. The average 160-acre farm will then raise from 30 to 50 acres of corn each year.

**A Young Man's Opportunity.**—If a young man begins farming on one of these farms when he is 20 years old, and continues until he is fifty, he will raise during his active life approximately 1200 acres of corn. It will make quite a difference to him and his family whether he follows indifferent methods of farming and gets an average yield of 30 bushels per acre, or whether he follows good methods and gets 40 bushels per acre. It will pay, and pay well, any boy who expects to raise corn to thoroughly master the subject, so he will be the one who will get the extra ten bushels per acre.

**Details.**—Nearly every large business is made up of a lot of details, and corn growing is no exception. The four general requirements for a good crop of corn are, good seed, good soil, good tillage and good climatic conditions.

Good seed is easily secured by selecting good ears of corn from good plants, and by carefully curing, storing, testing and grading it.

Good soil may be had in almost any part of the United States by properly caring for the land we have.

By practicing rotation of crops, by keeping live stock and feeding on the farm most of the field crops raised instead of selling them and thus losing fertility, by draining land that is too wet, and by keeping in check noxious weeds, land may be maintained at a high state of productivity.

Good tillage means doing the things which make the soil the best possible place for the crop to grow in. This requires a knowledge of the soil, of the movement of water in the soil, of the habits of plants, and of the methods by which plant food is liberated.

**Climatic Conditions.**—Good seed, good soil, and good tillage are within the control of the farmer. Climatic conditions are not, though he may do many things to guard against unfavorable weather. One can drain his land to avoid an excess of moisture and to make his soil warmer. He can regulate his tillage operations to conserve moisture in case of drouth and to aid in warming the soil if it is too cold. By manuring land and by growing clover occasionally, one can make a soil warmer, more retentive of moisture, and increase its producing power, so crops will grow more rapidly and thus ripen in a shorter time. Climatic conditions are usually favorable enough, so that with good methods of farming good crops can be grown practically every year.

Some farmers in the corn belt have raised 100 bushels of corn per acre. Let us set our standard at that and be satisfied with nothing less. It is a good plan to aim high, and a very poor plan to be satisfied with just ordinary results when it is reasonably possible to do better.

### Questions:

1. Why do you think it worth while for a boy to study about corn growing?
2. Name at least four conditions necessary to secure a good crop of corn.
3. What may one do to reduce the bad effects of unfavorable weather?

**Arithmetic:**

1. A and B each grow 40 acres of corn per year for 30 years. How many acres does each grow in the 30 years?

2. If B uses the best known methods of corn growing and secures an average yield of 10 bu. per acre more than A, how many bushels more corn will he raise in 30 years than A raises? How much will his extra corn be worth at an average price of 35c per bu.?

**SHAPES OF KERNELS OF CORN.**

**Selecting Ears of Corn.**—Every farm boy, and girl for that matter, should know what a good ear of corn should be like, and be able to select good ears from a field or a load. There is little doubt but that corn in any state in the Union might be made to yield from five to twenty bushels more than it does at present, were careful and good methods used in the selection and care of seed corn.

It is interesting and valuable to be able to look over a large number of ears of corn and pick out the best ones. There is nothing very difficult about it either, and anyone who will study carefully a few ears and kernels of corn will be able to understand the desirable points in a good ear of corn, and after one understands just what is wanted a little experience will make one quite a proficient corn judge.

**Kernels Vary.**—The end of an ear of corn that is attached to the stalk is the butt end. The other end is the tip. If you examine an ear of corn closely you will find that not all of the kernels are the same shape. The kernels at the tip of the ear are small and nearly round. The dent in the top of the kernel, if dent corn, is not deep or as plain as in the kernels in the middle of the ear. Some of the kernels are likely missing. Only the best-developed ears of corn are filled out at the tips.

The kernels at the butt end of the ear are larger and

are very irregular in shape. Some of them are three-cornered.

The kernels in the middle of the ear are rectangular and all of about the same size.

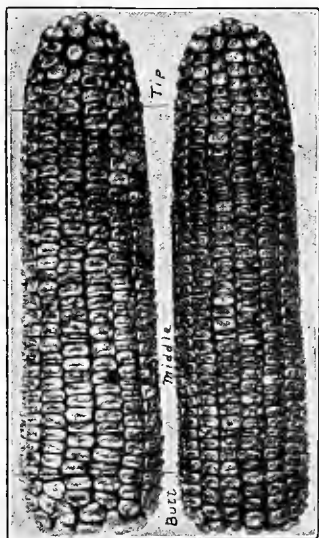


Fig. 30.—Good ears of corn, with straight rows and even kernels.

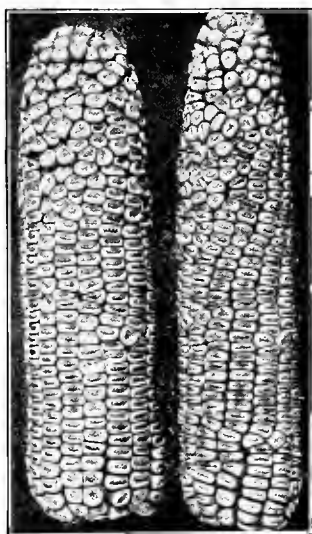


Fig. 31.—Poor ears of corn. Note the crooked rows and irregular kernels.

The rows of kernels on a cob should be straight. Find an ear of corn with straight rows. Find one with crooked rows. Notice that where the rows are crooked the kernels are not so even in shape. The butt of the ear is larger and may have extra rows of kernels. The kernels in these extra rows are mostly irregular. If a kernel is missing in one of the rows, see how the other kernels crowd out toward this place and are irregular in shape.

**Questions:**

1. Are all the kernels of an ear of corn the same shape?
2. What shape are the tip kernels? The middle kernels? The butt kernels?
3. What can you say of rows of kernels on a good ear of corn? On a poor ear?
4. What can you say of the tip of a good ear of corn?

**Arithmetic:**

1. If one increased his crop of corn 5 bu. per acre by careful seed selection, how much more corn would he get on 35 acres?
2. What is the value of five bushels of corn at 35c per bu.?
3. How many hours could one afford to spend if his time is worth 14c per hour, in selecting seed corn that would yield \$1.65 worth of corn more per acre?

**SIZES OF KERNELS OF CORN.**

**Variation of Corn Kernels.**—There is a great variation in the size of kernels of corn; and while this has little to do with the yield—that is, some varieties with comparatively small kernels may yield more than other varieties with large kernels—it is nevertheless important to select ears of corn on which the kernels are about uniform in size. A good corn judge should study these little details, because they have a very important relation to corn yields.

**To Compare Kernels.**—Shell kernels from the tip, the butt and some from the middle of an ear of corn, keeping the three kinds separate. Lay three of the even sized kernels from the middle of the ear together on a sheet of paper and draw a circle about them. Make the circle just large enough so the three kernels will lie flat within. (Circle about the size of a nickel.) See how many of the small tip kernels can be laid in this circle and how many butt kernels. This circle is about the size of

a hole in the plate of the corn planter. Notice how much thicker some of the butt kernels are than kernels from the middle of the ear.

Examine a corn planter, if possible, to see how it drops the corn.

It is very important to the farmer that all his seed corn be uniform in size, because corn is now planted by



Fig. 32.—Showing the relative size and shape of tip, middle and butt kernels of corn. The circle represents the hole in the plate in a corn planter, and the number of kernels of the different sizes that a planter would drop is shown. Photo by H. D. Ayer.

machines and unless the kernels are about the same size and shape the machine cannot drop the same number in each hill. If uneven sized kernels were used for planting, the number in a hill would vary as the number of kernels you were able to place in the circles you drew varied. Most

farmers like to plant three kernels in a hill, because they have found that three stalks to a hill give the best yields.

**Even Seed.**—Farmers can get even corn to plant by selecting even, straight rowed ears of corn, and by shelling off the tip and butt kernels, using this part for feed and saving only the more even kernels from the middle of the ears to plant. The whole crop on an acre of corn depends on a few ears of seed corn.

### Questions:

1. Do the size and shape of kernels of seed corn make any difference to the farmer?
2. How can farmers get even seed corn?
3. If the tip kernels were put into a planter, would it drop too many or too few?

### Arithmetic:

1. After the tip and butt kernels of corn have been shelled off from an ear, count the number of rows of ker-

nels; then count the number of kernels in one row. How many kernels on the ear of corn?

2. Find how many hills of corn on an acre when corn is planted in hills 3 ft 8 in. apart each way.

Note.—There are 160 sq. rds. in an acre, and each hill of corn takes up 3 ft. 8 in. x 3 ft. 8 in. or 13 4-9 sq. ft. of space.

3. If three kernels are planted in each hill, how many ears of corn like the one you counted are required to plant an acre?

#### PARTS OF A KERNEL OF CORN.

**Examining Kernels.**—It is not always easy to believe that there is a quite complete, though small, corn plant in each kernel of corn. If you will soak a few kernels of corn for a few moments in hot water it will be easy to dissect them, and they furnish a very good object-lesson.

A kernel of corn consists of three parts—an outside shell or seed coat; a little speck of life, or the embryo, and about the embryo a white, starchy substance or food portion.

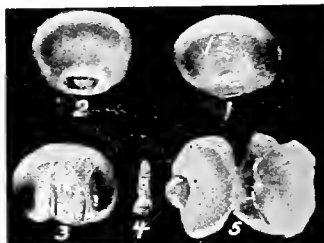


Fig. 4.—The parts of a kernel of corn. 1. The side of the kernel on which the embryo is found. 2. The side opposite the embryo. 3. A kernel with the embryo and seed coat removed. 4. The embryo. 5. The seed coat removed from the kernel.

**The Seed Coat** may be easily removed from a kernel of corn that has been soaked for a few minutes in hot water. It is hard and tough. Its purpose is to protect the parts within. It protects them from heat, cold, and moisture.

**The Embryo.**—The speck of life, or embryo, may be taken from a soaked kernel of corn by the use of a sharp knife or a needle. It is really a very tiny live corn plant, and is found bedded near the tip of the kernel, in the white starchy part. This embryo has a root and



a stem. The stem is not green, however, because it has been shut up in the dark. If corn is properly ripened and kept dry the little plant within each kernel will stay alive a long time, and be ready to grow when the kernel containing it is put into the ground and supplied with heat and moisture. If corn be allowed to freeze, perhaps thaw out and freeze again, the little embryo within a kernel is not likely to live, and the kernel would not grow if planted. It is for this reason that farmers are careful to select for seed well ripened ears of corn, and to store them safely.

**Food Material.**—After the seed coat has been removed and the embryo taken out, a large part of the kernel is still left. It is the food part. It makes food for us when the corn is ground into meal; or, when the seed is planted and the embryo begins to grow, it is this part which furnishes the embryo with food until it has developed roots and can get its food from the soil. The large kernels have more of this food material than the small ones. A stronger plant will grow from a large kernel than from a small one, because of the greater amount of food material the larger kernel contains for the early growth of the little plant. This is one reason why good plump kernels are better for seed.

### Questions:

1. A kernel of corn consists of what parts?
2. Tell all you can about each part.
3. Where in the kernel did you find the embryo?
4. What would injure or kill the embryo?
5. How should corn which you mean to plant be kept?
6. From which kernels come the strongest plants? Why?

### Arithmetic:

1. If corn is planted May 15th and is struck by a frost Sept. 1st, how many days will it have in which to mature?

2. A bushel of seed corn will plant seven acres in check rows and is worth \$2.50 per bu. What is the cost of seed corn per acre?

3. A pays five dollars per bu. for seed corn, B pays \$2.00 per bu. Each one plants seven acres with his bushel of seed. How much more corn must A get per acre than B to pay the extra amount for his seed, if corn the following fall is worth 40c per bu.?

#### TESTING SEED CORN FOR GERMINATION.

**Germination.**—A seed is said to germinate when it sprouts or begins to grow. Most farmers are careful to use kernels from the middle of the ears of corn, because the kernels are more even in size and shape and the corn planter, can, therefore, drop the required number, usually three, to every hill. Suppose one ear of corn which has five hundred kernels has been frozen or otherwise injured so that the embryo in each kernel is dead. If the corn planter drops one of these bad kernels with two good ones in every hill until the five hundred bad kernels are all planted, there will be five hundred hills each with one stalk missing. This would reduce a farmer's yield; and the more of such ears he planted, the greater would be the reduction of his yield. If, on the other hand, all the seeds dropped in every hill were seeds that would grow, the farmer could be sure of a good stand of corn. This is important, because it costs as much to prepare the land, plant and cultivate the crop for a poor stand as it does for a good stand.

**Will It Grow?**—One cannot always tell by looking at an ear of corn whether or not the kernels will grow. A farmer, to make sure he is planting only good seed, must test his corn. He may test one hundred kernels taken at random from a number of ears or a sack of corn, but if he finds that only 80 per cent of his corn will grow he must use this poor seed or buy seed. A much safer and a very easy and simple way is to test each ear before it

is shelled. One wants to know if all or most of the kernels on an ear of corn will sprout or grow. If he takes ten kernels from one ear, and finds that all of the ten kernels sprout, he can safely assume that the rest of the kernels on that ear will grow. That is a good ear for him to plant.

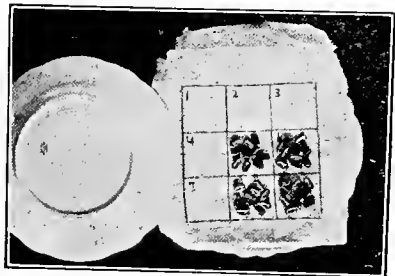


Fig. 34.—A simple germinator consisting of a plate partly filled with sand, a cloth marked in squares for the corn from each ear to be tested, and the cloth and plate with which to cover the corn.

If he takes ten kernels from another ear, and finds that none or less than half of them sprout, he rightly assumes that the rest of the kernels on that ear would not be likely to grow. That is not a safe ear to plant.

**To Test Corn.**—By testing each ear one may throw out the poor ones and save the good ones, which enables him to use his own seed and to be sure of planting only good seed. A simple germinator may be made as follows: On a piece of white outing flannel draw with a soft peneil a six-inch square, and mark it off into nine two-inch squares, numbering the small squares from one to nine. Place the cloth thus marked over a plate of sand or dirt. The next step is to number nine ears of corn. This is easily done by fastening a small tag to the butt of each ear of corn with a pin, as shown in Fig. 35. Take ten kernels from ear No. 1, selecting them from different parts of the ear, and place them on square No. 1. Continue until each square is supplied with ten kernels from the ear of the corresponding number. Moisten the material in the plate thoroughly, cover with another cloth and another plate, to prevent too rapid evaporation, and set in a warm place. Put up carefully the nine ears of corn for future comparison.

The germinator should be examined from time to time

to note the germination of the kernels. If kept warm and moist the corn should all germinate in five to eight days. Kernels slow in germinating should be counted as worthless, as they would probably not grow in the field if unfavorable conditions prevailed.

For testing a large amount of seed corn, as for ten to forty acres, a box two to four feet square may be used in place of the plates.



Fig. 35.—Nine ears of seed corn numbered for testing.

### Questions:

1. For what reason should a farmer test his seed corn?
2. What are the advantages of testing each ear over testing 100 kernels out of a sack full of shelled corn?
3. How would you proceed to test 200 ears of corn?

### Arithmetic:

1. If seven of the ten kernels taken from an ear of corn grow, what per cent does the ear germinate? If nine kernels grow, what per cent germinates?
2. If twenty ears of corn will plant one acre, what per cent of the corn in a field will be missing if the corn from one of the twenty ears will not grow? If the corn from three ears will not grow?
3. If a man tests 400 ears of corn, and 90 per cent of the ears are good enough to plant, how many acres of corn will the good seed plant? (Assume that twenty ears will plant an acre.)
4. A man can test 400 ears of corn in 6 hours. His time is worth 14 cents per hour. If the 400 ears will plant

18 acres, how much does it cost him per acre to test his corn? If corn is worth 30 cents per bushel in the fall, how much more corn per acre must a farmer get to pay him for thus testing his seed?

#### CORN CULTURE.

**The Corn Field.**—In the spring of the year, when most farmers are preparing their fields for corn, will be a good time to study the planting phase of the corn subject. In the first place let us see on what kind of soil our neighbors and fathers and brothers are to plant corn. Land that produced clover or was pastured last year is best, as the clover and grass roots have filled the soil with vegetable matter, a very necessary condition for good crops. It would be better if the land were plowed last fall, as fall plowing gives the soil a chance to settle so it will not dry out readily.

Fall plowed land should be thoroughly disked in spring, before planting to corn, to insure a fine, mellow seed bed, to destroy weeds and to form a surface mulch to check the evaporation of water.

If there is no clover or pasture sod for corn, other well drained land, fall plowed, well manured and the manure thoroughly disked into the surface of the soil before planting, is the next best place for corn. The effort in any case should be to have a rich, firm soil, with a couple of inches of loose soil on top to check the evaporation of moisture.

Seed corn should be the best that can be secured, and should have been thoroughly tested to make sure it will grow when planted.

**Grade Seed Corn.**—Practically all corn is now planted with a machine, and unless the kernels are of uniform size no machine can drop the same number of kernels in each hill, and it is important to get the right number of kernels per hill.

As corn is shelled from the ear there is always more or less irregularity in the kernels. This is especially true if

the tip and butt kernels are shelled with the rest. Even if this is not done there are some irregular kernels in the middle of the ear, owing to imperfect growth. Examine an ear of corn and you will see the irregular kernels at the tip and butt and a few in the middle. Irregular kernels are easily removed from any sample of corn by running it through any of the modern corn graders.

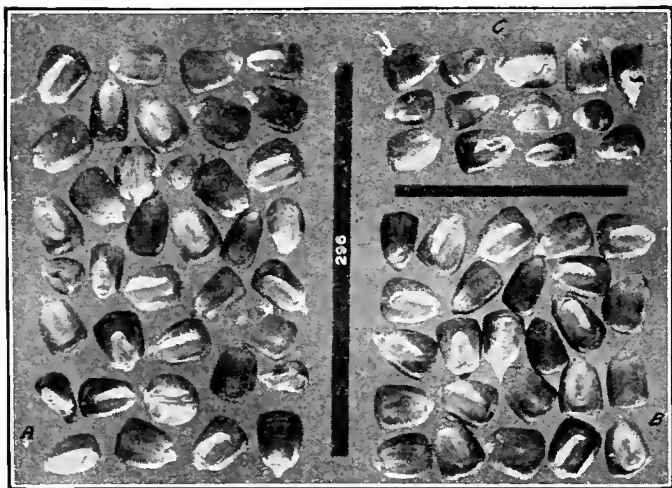


Fig. 36.—(A) Corn as shelled from whole cob. (B) Corn after it has been graded. Note uniformity of kernels. (C) Small and irregular kernels removed by the grader.

Corn graders are fitted with screens with holes of certain sizes and shapes. As the corn is run through, all of the small and irregular kernels are separated out, leaving only the regular ones and the kind a planter can plant uniformly. A corn grader will cost about \$10.00, and is well worth the money to any one who is planting any considerable amount of corn. If one has no corn grader it is certainly advisable to shell off tip and butt kernels and keep them out of the seed corn.

**Planting.**—Corn is as a rule planted in May. There is, however, no set date for planting, but a good practice to follow is to plant as early in the spring as the soil can



Fig. 37.—Planting Corn. Straight rows indicate good workmanship and are a joy throughout the year.

be and is well prepared and is warm enough so the seed will germinate. There is nothing gained by planting corn in cold, wet, poorly prepared soil, for in such condition, seed, even if good, is very liable to rot in the ground.

Probably one very general mistake is made in planting corn too deep. Corn cannot be made to root deep simply by planting deep. The roots will go wherever the soil conditions are most favorable. On ordinary land it is not wise to plant corn more than from one to two inches deep.

### Questions:

1. What is a good crop to precede the corn crop?
2. Why would you prefer fall plowing to spring plowing for corn?
3. What is gained by grading seed corn?

### Arithmetic:

1. It costs 10 cts per bu. to grade seed corn; what does it cost per acre if a bushel of corn will plant 7 acres?
2. If a man were to spend five hours shelling off tip and butt kernels and picking out irregular kernels from a bushel of seed corn, how much would it cost him if his time is worth 14 cts per hour? How much would it cost him per acre? (See example 1.)

## REASONS FOR THE CULTIVATION OF CORN.

**Moisture in the Soil.**—The more information one gains concerning any line of work the more interesting will that work be to him. As cultivation has more to do with the production of good crops of corn than has any other operation, it should be done intelligently.

One of the main reasons for cultivating corn is to save moisture in the soil. There are two ways by which moisture is taken from the soil: first, by the growing crops and, second, by evaporation from the surface of the soil. The water that is evaporated is worse than wasted. It is lost to the crop and its evaporation tends to make the soil cooler. (Demonstrate this by moistening the hand and exposing it to the air.) The hot sun and the moving air, the wind, greatly hasten evaporation, hence it is evident that if the part of the soil in which the moisture is held can be separated from the sun and wind much less moisture will be lost by evaporation.

**Movement of Moisture.**—Moisture moves in the soil by capillary force. For example, two particles of sand lie close together and one is wetter than the other. The dryer one will attract some of the water from the other until they both are equally wet. This capillary movement of water may be seen very plainly by following this plan as suggested: Fill a glass half full of sand and pour in enough water to thoroughly wet the sand, being careful not to wet the sides of the glass. Now fill the glass with dry fine sand and watch the moisture creep upward. The water is moving by capillary attraction. Moisture will move by capillary force in any direction, but always from moist to dryer soil.

**Surface Mulch.**—If you will go out in a field, on a bright day, where cultivation is being done, you will notice that very soon after the cultivator has gone over the ground the surface soil begins to look dry, while the surface soil where it has not been cultivated appears more moist. Moisture is being evaporated from both surfaces, but where the soil is firm moisture moves up from below



to replace that evaporated; and this process will continue, if not checked, until the soil is robbed of all available moisture. The cultivated portion is so loose that the moisture cannot readily pass up through it, as the particles of soil are not close together, hence evaporation is checked. The soil made loose by the cultivator separates the moist soil from the sun and wind and evaporation takes place very slowly, because it is difficult for water to pass through loose soil. In this way cultivation conserves moisture.



Fig. 38.—A Two-Row Cultivator at Work. Many farmers are now using these larger machines. One man can do nearly twice as much work with such a machine as he can with a one row cultivator.

Too much attention can hardly be given to maintaining this surface muleh, or loose soil on top, for as soon as the surface soil becomes packed against the moist soil below, the moisture moves to the surface, where more water may be lost by evaporation than is used by the growing crop. A shower of rain just sufficient to pack the surface may be more injurious than beneficial to a crop, by causing a great loss of moisture, unless the soil is cultivated soon after the shower.

**Destroy Weeds.**—Another reason for cultivating is to destroy weeds. The smaller the weeds are the easier

it is to kill them. On this account it is important that soil be so worked that most of the weeds are destroyed before the corn is planted, as it is difficult to cultivate very young corn and the weeds may get ahead of the corn. It is also cheaper to cultivate with a large harrow than with a cultivator. Of course corn may be harrowed after it is planted or even after it is up, but the less harrowing necessary at this time the better, as more or less corn is injured every time the field is harrowed.

There are usually fields in the neighborhood that were not well prepared before the corn was planted. In such fields it will be observed that the weeds get quite large before the corn is large enough to be cultivated. In fields well prepared before corn is planted very few weeds will be seen, and those appearing are small and easily killed at the first cultivation.

**Aerate Soil.**—The third reason for cultivating is to aerate the soil, i. e., to open it and let air into it. This stimulates the decomposition of vegetable matter, thus more plant food is liberated.

Still another reason for cultivation is to keep the soil loose, that rain which falls may be readily absorbed, thus making a larger supply upon which to draw when a dry spell comes.

### Questions:

1. What is the main reason for cultivating corn?
2. In what two ways is moisture taken from the soil?
3. How does cultivation check evaporation?
4. Give another reason for cultivating corn.

### Arithmetic:

1. A team travels  $2\frac{1}{4}$  miles to cultivate an acre of corn planted 3 2-3 ft. apart each way. How far must they travel to cultivate 8 acres?
2. If a team travels 18 miles with a harrow 12 ft. wide, how much land would it harrow?
3. How many times can one afford to harrow land to save one cultivation? (See two examples above.)

## METHODS OF CULTIVATING CORN.

**Depth to Cultivate.**—There seems to be an unsettled question among farmers as to how deep to cultivate corn. Apparently there is no rule that one can safely follow, for the conditions vary with soils and seasons, so it is largely a matter that must be settled by the individual farmer and depends entirely upon the depth of the corn roots. In a dry loose soil corn roots will grow nearly straight down, while in a heavy or more moist soil they will spread out near the surface of the ground. Roots naturally grow where there is available plant food; and that, we have learned, is where there is heat, air and moisture. In wet years they find this condition near the surface, and in dry years or in dry soil they must go deeper down for the plant food. The accompanying cut shows how corn roots usually grow. (Fig. 39.)

**Roots of Corn.**—A very interesting study of the root system of corn may be made by taking a rather blunt wooden paddle and carefully scraping away the loose soil between two hills of corn, until the roots are exposed. One may then observe the roots, how far they spread out from the hill of corn and how near the surface they grow. As a rule, when the corn is a foot high the roots from the rows will be overlapping and within one to four inches from the surface, depending upon how wet the soil is and how recently and how deeply cultivated.

**Results of Deep Cultivation.**—From the above facts it is quite evident that if the cultivator is run too deep some of the roots will be cut off. The roots are the feeders of the plants, consequently every one that is cut off decreases the amount of moisture and plant food the plant will get. The effects of too deep cultivation may be seen by cutting down in the soil four inches, with a sharp spade, two to four inches from a hill of corn. Then note results. If it is a dry, hot day the leaves will soon begin to curl up on the plant thus injured, showing that a portion of its water supply has been cut off.

It is necessary, however, to cultivate to kill weeds, to let air into the soil and to form a surface mulch to save

moisture; and many times it is necessary to cultivate deep enough to injure corn roots in order to accomplish these various things; but the aim should always be to cultivate no deeper than necessary.

If deep cultivation is to be practiced at all it should be done while the corn is small, as it is injured less at this time.

**Cultivator.**—The kind of cultivator used has much to do with the depth of cultivation. If a cultivator with

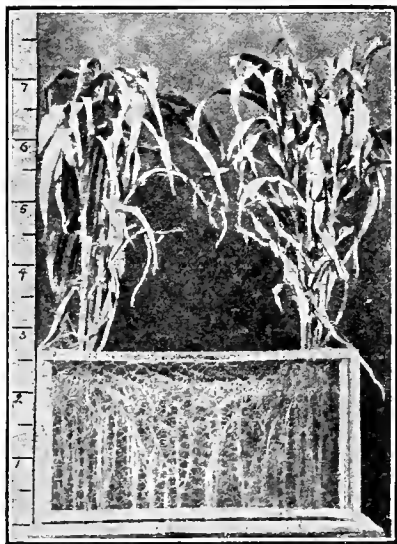


Fig. 39.—The Root System of Corn  
Kansas Bul. No. 147.

two large shovels on a side is used, it must be run deeper to cover all the space between the rows, than one which has three, four or five shovels on a side. The small shovels and more of them do finer, shallower work than do the large shovels; but where corn has been neglected until the weeds are large, the larger shovels are better, because they do not clog up so easily and because they plow out the weeds instead of cultivating them.

**Surface Cultivators.**—At present

many farmers are using what are called surface cultivators. In place of shovels there are two or more knives or blades that run an inch or so below the surface of the ground, separating the surface soil from the soil below and cutting off just below the surface all weeds growing between the rows. If possible, examine cultivators with these different kinds of shovels and note the work they do.

**Check vs. Drills.**—Many farmers drill in their corn, i. e., plant it in rows only one way. It can then be cultivated only one way and the weeds growing between the hills cannot be reached with the cultivator. If these weeds cannot be covered by so running the cultivator as to throw dirt against the rows they must be pulled by hand or allowed to grow.

Other farmers plant their corn in check rows. As they can then cultivate it both ways they can get all the weeds with the cultivator, excepting an occasional one growing in the hills. Try to look over fields of corn planted each of these ways, at different times during the summer, and see which fields are the cleaner. If you can find corn planted each way in the same field or on the same farm, and receiving the same number of cultivations, it will be a better comparison. As one of the main objects in growing corn is to clean the land of weeds, it is better on weedy land to plant corn so it can be cultivated both ways. If corn is cultivated both ways it is easier to keep the surface smooth and level; which is desirable, as a ridged surface is hard to work down, and more surface is exposed, causing more evaporation.

### Questions:

1. Why is it not wise to cultivate corn too deeply?
2. What can you say about different types of cultivators?
3. What can you say about planting corn in drills or in check rows?

### Arithmetic:

1. The time of a man and team is worth \$3.50 per day. What is the cost per acre to cultivate, if they cultivate 8 acres per day? How much does it cost to cultivate an acre of corn six times?

2. How many bushels of corn at 40¢ per bushel must a farmer get to pay for cultivating his corn six times?

3. The time of a man and three horses is worth \$4.25. What is the cost per acre if they cultivate 14 acres per day? (Three horses can handle a two-row cultivator.)

## SELECTION OF SEED CORN.

**Selection Neglected.**—A comparatively small amount of seed corn is needed each year, on the average farm, as one bushel will plant from six to eight acres. On this account the matter of saving seed corn is liable to be neglected, as farmers are very busy in the fall with other duties. Were the saving of the price of seed the only advantage gained in selecting seed corn on the home farm, one might be justified in neglecting it. But this is by no means the case.



Fig. 40.—Two varieties of Dent Corn growing side by side and given similar treatment. The variety on the right is mature, as shown by the drooping ears; the one on the left is still quite green, as shown by the erect ears. Both varieties are Yellow Dent Corn, but one has been made later than the other by being grown under different conditions.

**Adapted to Localities.**—

Corn in some respects is a tender plant, very easily affected; unfavorably by cold weather conditions or cold wet soil, and favorably by warm weather and warm soil. On this account corn grown under one condition for several years becomes adapted to those conditions and is not well suited to other conditions. No locality is suited to produce seed corn for any very large territory. Corn that does well in the north will grow and do well farther south, but as a rule a larger corn can be produced on most of the well drained soils in the south, and will yield more than the comparatively small corn grown farther north. Corn suited to

Indiana conditions will grow if planted in Northern Minnesota, but in average years it will

not mature well, as the season is too short. The same varied conditions may be found on different farms in the same locality. Farms with a light, warm soil, or well-drained farms on which the soil is kept highly productive by good methods of cropping, manuring, etc., can grow and mature a larger variety of corn than can farms in the same neighborhood with heavy, poorly drained soils or soils in poor condition.

If one wishes to get the best results from growing corn, he cannot afford to neglect selecting his own seed from his own farm. By selecting the best ears of corn from the best stalks one gets seed from the plants that are best adapted to the conditions of the farm, as shown by their superior development the previous year.

**Large Varieties.**—A mistake very commonly made is to select too large or too late a variety of corn. Every one likes to grow large ears of corn, and on this account, when seed is secured from some other community or from seedmen, a larger variety than is suited to the conditions is liable to be chosen. Large ears of corn are not necessary to large yields, and it is far better to be sure of a good crop, by using a variety that will mature, than to attempt to grow too large a variety and have a partial or complete failure occasionally.

**Varieties May be Made Larger.**—It is well to select a variety of corn that will be quite sure to mature in your locality. If the soil is well drained, well cultivated and kept at a high state of productivity by growing clover occasionally and by keeping live stock and manuring it, and if the climate will permit of the growing of a larger variety, one can in a few years make the variety larger by selecting the larger ears. Such conditions will practically insure a good crop of corn each year, unless one selects too large ears and thus makes his variety too late. If in a few years you cannot improve the corn to the size you wish it, it is undoubtedly due to the fact that your conditions are not favorable for a larger variety; and were you to get a larger variety from some other locality you would be very

likely to lose your crop or have soft corn, in the ordinary years.

**To Make a Variety Early.**—If one wishes to make a variety of corn he is growing earlier, he can do it by selecting the ears that ripen first. Such a selection cannot be made after all of the corn is ripened. If one cannot select seed when the corn is ripening, he can make some progress toward earliness by selecting the small ears of corn with comparatively shallow kernels. Large ears with deep kernels are very seldom found in an early variety of corn.

**Questions:**

1. Give two reasons why it is advisable for a farmer to select his own seed corn from his own farm.

2. Why is it better to have a variety of corn that is a little too small rather than one that is too large?

3. Give two ways by which a variety of corn may be made larger.

4. If you wish to get corn that will ripen earlier, how and when would you select it in the field? How would you select it from a large number of husked ears?

**Arithmetic:**

1. A plants 7 acres of corn with 1 bu. of seed and it yields 40 bu. per acre. How many bushels of corn does he get? Extra good seed would have increased the yield 10 per cent. How many more bu. of corn would he have received had he used good seed? How much would the increased yield be worth at 40c per bu.? How much would a bushel of extra good seed corn have been worth to that farmer?

2. There are 3240 hills of corn on an acre when planted 44 inches apart each way. If one gets 3 10-oz. ears from each hill, how many bushels of corn will he produce?

**HOW TO SELECT SEED CORN.**

**Kind to Select.**—If one is to get the best seed ears from a field of corn, he must have well in mind what a really good ear of corn looks like, and select only such ears. A great advantage of selecting seed corn in the



field over selecting it from a load of husked corn is that the stalks may be considered as well as the ears. No matter how good an ear of corn may be, it should not be taken from a poor plant. Usually good ears come from good plants, but there are exceptions. It is well to select more seed corn than is needed, then another and more careful selection may be made in the spring before planting.

**Time to Select Seed Corn.**—In order that seed corn may be sure to keep over winter and still germinate readily it must be taken from the husk and placed where it can dry out before freezing weather. If one weighs an ear of freshly husked ripe corn, then leaves it in a living room for a month and weighs it again, he will find that it has lost in weight. The loss in weight is from the evaporation of moisture. Moisture is detrimental to seed corn. Select and husk seed corn before October 1st.

**Condition.**—The first thing to consider in an ear of corn for seed is condition. It must be firm and solid to the touch and the kernels should not be loose on the cob. Loose kernels indicate immature ears, which must be avoided, as corn from such ears is not likely to germinate and if the kernels do germinate the plants are quite likely to be weak. The kernels should be bright in color and free from mould or other injury.

**Shape of Ear.**—Ears should be uniform in shape and size, and each ear should be as nearly the same size at tip and butt as possible. The tips should be well filled out, as this indicates hardness and well-matured corn. Large butts should be avoided as they indicate coarseness and are hard to dry out. There are, also, more irregular kernels on these large butts than on properly formed butts.

The rows of kernels should be straight, as crooked rows indicate an imperfect type, which is as undesirable in corn as in animals. If the rows are crooked there are more irregular kernels. These are undesirable, as they cannot be planted uniformly with a planter.

**Size of Ear.**—The size of ears will depend upon the variety and the locality. But do not select too large ears, as they will have a tendency to make the variety later; which may result in considerable loss in unfavorable seasons. Select the medium sized, well matured ears as nearly uniform in size as possible.

**Kernels.**—Ears with kernels as nearly uniform in type as possible should be selected. There are good ears of corn with different types of kernels, but for any one variety it is important that the kernels be uniform, as only such kernels can be planted uniformly by machinery.

The most desirable kernels are deep, which indicates a large amount of corn in proportion to cob, but the point can easily be overdone, as deepkerneled varieties are usually late in ripening.

**Space between Kernels.**—It is desirable to have just as much corn around the cob as possible, consequently any space between the kernels is to be avoided. These spaces are caused by rounded kernels, and are more common and larger in flint than in dent varieties.

**Selecting.**—It is a comparatively small task to go through

the field with a sack and select the desired ears, or when the corn is husked from the standing stalks the ears may be selected as the husking is being done and the seed ears thrown into a sack or small box on the

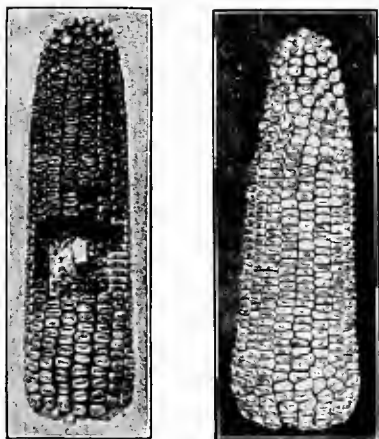


Fig. 41.—The ear on the left represents a good type of ear to select for seed. It has even, regular rows and kernels and shows a good proportion of corn to cob. The ear in the right is just opposite in character, and is not a desirable ear to select.

side of the wagon. This is preferable to selecting the best ears from the load or crib after it is husked, as the stalks may be considered in the selection.

**Application.**—It is hoped that the boys and girls who read this lesson will take an interest in the selection of seed corn, and at least observe how it is done on the home farm and on other farms. Some of the spare time during the fall may be profitably spent in helping with the selection of seed, and much information gained by asking your fathers and brothers why they select certain ears and discard others. Good seed corn is worth from \$2.00 to \$3.00 per bushel, and if some boy wishes to make a little spending money he can do it quite easily by carefully selecting and storing a few bushels of seed corn. Farmers will gladly pay a good price for such seed.

**Questions:**

1. When should seed corn be selected, and why?
2. What are some of the advantages of selecting seed corn in the field from the standing stalk over selecting from the load or crib?
3. For what reasons would you select ears that are sound, with kernels tight on the cob?

**Arithmetic:**

1. A bushel of seed corn is worth \$2.00 and will plant six acres. What is the cost of seed per acre?
2. A fair sized ear of corn will weigh about 10 ozs. What part of a pound does it weigh? How many such ears of corn in a bushel? (A bu. of ear corn weighs 72 lbs.)
3. A boy selects 200 10-oz. ears of seed corn in one day. How many bu. does he save? What is it worth at \$2.00 per bu.?

**STORING SEED CORN.**

**To Keep Germ Uninjured.**—We have learned (page 82) that every kernel of corn contains an embryo or germ, which is a very small, live corn plant. If the kernel is to be of any value as seed this germ must be kept alive and strong. This little plantlet or germ is very

similar to any plant. Freezing, under certain conditions of moisture, will kill it. This germ can stand freezing only when quite dry, as when in this condition it is dormant. Trees and other plants that live from year to year are very liable to be killed by cold winter weather if kept growing until late in the fall. Under normal conditions such plants stop growing several weeks before cold weather sets in; which gives them a chance to "harden up" or as we might say, "ripen." It is evident, then, that if we would keep our seed corn in good condition it must be so handled as to prevent injury to the germ in each kernel.

**Keep Dry.**—The first essential is to select the seed ears before they have a chance to freeze in the field, for many times the corn may not become sufficiently ripe to be thoroughly dry; and if not dry, freezing injures the germ. After the husk has been removed, the ear will dry out rapidly if placed where it has an opportunity to do so. Seedsmen appreciate the necessity of drying seed corn immediately, and they store it in a room in such a way that air can circulate about it freely and thus carry off the moisture. They very often use artificial heat, as stove or furnace heat, to assist in this drying operation.

**In the Attic.**—A farmer, as a rule, saves only a small amount of corn and cannot afford a special storehouse for it. Probably the most satisfactory way of drying corn and keeping it dry, on the farm, is to store it in the attic over the kitchen. Here ventilation can be supplied by opening windows, and the heat from the kitchen stove assists in drying out the corn and in keeping it dry. Where one has no attic or has more corn than he can store there satisfactorily, it may be placed on a barn floor or in a vacant room in the house or other building. It should not be piled over eight to ten inches deep, as it may heat or sweat if piled deeper. A good circulation of air should be supplied, as this aids in drying the corn, and it is very essential that it be thoroughly dried before cold weather. If corn is thoroughly dried and kept

dry it will stand freezing, but it is much better if it can be kept where the temperature is slightly above freezing.

Seed corn should never be placed above a stable in which animals are kept, or over a bin of grain, as the steam and breath from the animals, or the steam that may arise from a bin of grain if it heats even slightly, will keep corn moist enough to greatly reduce the vitality of the germ.

**Good Seed Essential.**—A kernel of corn is a very little thing, but it is a very important factor in the production of good yields. But very little time is necessary to select and care for all the seed corn needed on the average farm and very few farmers can afford to neglect this part of the farm business.

Neglecting to save and properly care for seed corn may save one or two days' time in the fall, but it may also mean that poor seed corn or corn not well adapted to one's conditions will have to be planted the next year. Poor seed corn means a partial or total loss of the corn crop, which may result in a very great financial loss.

**Questions:**

1. What will injure the germ in a kernel of corn?
2. Why should one take seed corn in from the field before frost?
3. How do seedsmen store corn, and why?
4. How may farmers store their seed corn?

**Arithmetic:**

1. If it requires 20 ears of corn to plant an acre, how many ears are required to plant 40 acres?
2. If a man can select 800 ears of corn in 2 days, how much will it cost him to gather the 800 ears, if his time is worth \$2.00 per day?
3. How many bushels of corn in 800 ears of corn weighing 10 oz. each (72 lbs. per bu.)? How much is it worth at \$2.00 per bu.?

**METHODS OF STORING SEED CORN.**

**Drying.**—Free circulation of air about seed corn is necessary to dry it out, consequently many devices have

been used for storing it easily, quickly and in such a way that this end will be accomplished.

The old practice, of braiding several ears together by the husks and hanging them up, is a satisfactory way to keep the corn, but requires a great deal of unnecessary labor.



Fig. 42.—A simple device for putting up seed corn to dry. It is made of a 4x4 standing upright on a square piece of plank for a base. Finishing nails are driven in each side about 2½ in. apart. An ear of corn is stuck on each nail.

**A Simple Device.**—A very simple and practical device for putting up seed corn is illustrated in Fig. 42. This device is called a "corn tree." Any boy who can use a saw and hammer can make one in a short time. To make it, saw a 2x4, or better, a 4x4 off five or six feet long. To the bottom end of this spike a plank about 12 in. square, to form a base sufficiently large so the tree will stand firmly erect on the floor. It is well to put some short braces from the edges of the plank up to the 4x4 to stiffen it. A row of finishing nails, nails with small heads, are driven in each side of the 4x4 and about 2½ inches apart. An ear of corn is easily stuck on each nail by jamming it on butt first. The nail sticks into the pith of the corn cob. This tree may be placed in the attic or any other convenient place where the corn will be kept dry. If the tree is six feet high it will hold about 100 ears of corn, or enough to plant about five acres. If one wishes to put more corn on the tree the corners of the 4x4 may be beveled off, making it eight sided.

There will then be room for eight rows of corn. If this is done a tree six feet high will hold 200 ears. It is well to plane the 4x4 smooth, so that numbers may be placed at the base of each nail, thus making it easy to number the ears if one wishes to test each ear for germination.

**A Large Frame.**—Another excellent way of storing corn is to make a frame 4 to 6 feet high, and as long as needed or as is convenient. Boards one inch thick and of the desired length are nailed to 2x4's as shown in Fig. 43. A cross piece to act as a foot is nailed across the bottom of each 2x4 and braced to hold the frame upright. 10d nails are driven through the board frame about 2½ in. apart and from either side, and slanted up slightly so an ear of corn may be stuck in each nail, butt first. A frame five feet high and five feet long will hold about 500 ears of corn on each side, or enough to plant at least 50 acres. The ears of corn may be numbered for testing if desired.

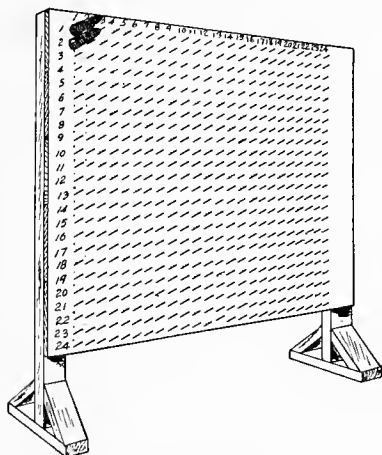


Fig. 43.—Another handy device for storing seed corn. See description above.

**Slatted Shelves.**—Another very good way to store seed corn is on shelves made against the wall in the store room, the shelves to be made of narrow strips instead of boards, and but six to eight inches apart. The seed ears can be placed on these shelves one or two deep and will readily dry out. They may be easily numbered for testing by sticking small pieces of pasteboard to the butt of each ear with a pin. See Fig. 35.

**Wire Baskets.**—Long, slender wire baskets are very easily made of poultry netting or other closely woven fencing. The two ends of a strip of fencing three to five feet long are fastened together, and a board or another piece of the netting put in for the bottom. Such a basket will hold considerable corn, and hold it in such a way as

to allow it to dry readily. These baskets are preferable to the other methods given above only when a large amount of seed corn is to be stored.

**Questions:**

1. Why is a good circulation of air about seed corn necessary?
2. Describe a corn tree.
3. What can you say of the use of wire baskets for storing seed corn?

**Arithmetic:**

1. How many feet of lumber in a piece of 4x4 6 ft. long? How much is it worth at \$30 per thousand feet?
2. If it takes about 2 hours to make a corn tree, how much does it cost for labor if the boy's time is worth 6 cents per hour?
3. How many feet of lumber required to make a frame 5 ft. square as shown and described on page 105?



## CHAPTER VI.

### POTATOES.

#### THE POTATO CROP.

**Importance.**—The potato crop generally receives very little attention, yet nearly every farmer raises enough for his own use at least. Potatoes form a considerable portion of the Nation's daily food.

The potato crop bears an important relation to the business of the farm. If they are raised in any great quantity they are one of the cash crops. That is, they are usually sold for cash, the same as wheat, instead of being fed on the farm, as hay or corn or such root crops as mangels and turnips.

**Cost Per Acre.**—A potato crop represents a much more intensive system of farming than does the raising of grain or hay. The crop requires a greater amount of labor per acre, and as a rule yields a much larger income in return. It costs on the average about \$25.00 per acre to produce a crop of potatoes, compared with about \$9.00 per acre to produce wheat and \$7.00 per acre to produce hay (two crops in one year). The average yield of potatoes in the United States for several years is about 90 bushels per acre and the average price about 55 cts. per bu. Thus the crop brings an average gross income of about \$50.00 per acre. The average yield of wheat in the United States is about 14 bushels per acre, which at the average price (73c) yields a product worth about \$10.00.

There is much more work required to raise an acre of potatoes than to raise an acre of grain, yet the larger yield in money value makes them at least as profitable, and often much more profitable to grow than grain.

If a farmer has but a small amount of tillable land he can often get as large an income from a few acres of potatoes well cared for as many farmers get from a hundred acres of grain.

**Undesirable Features.**—There are several reasons why potatoes are not more largely grown. (1) Most farms in the northwest are large, and the farmers favor crops that require less labor than the potato crop requires. (2) Potatoes are a bulky crop and rather expensive to market. Often, where they must be hauled several miles to a railroad or shipped for a long distance, the cost of marketing is so high that little is left to pay the farmer for growing them. (3) Potatoes are a perishable crop.



Fig. 44.—A potato field on farm of Mr. C. E. Brown, Elk River, Minn.  
Note scarcity of weeds and straight rows.

They cannot be held over to wait for a higher price, as can grain or hay. (4) On account of potato bugs the vines must be sprayed with poison several times, which is quite expensive. (5) A disease known as blight often attacks the leaves and causes small yields and rotten potatoes. The tubers often rot in the ground, probably due to some other disease not well understood. (6) Scab, which affects the tubers, often causes loss by reducing the quality and yield of potatoes.

Many farmers, who live near a good market and are willing to do the extra labor required for the larger income, are overcoming all the above mentioned difficulties and are making good profits raising potatoes, as there are simple treatments for most of the diseases and pests that injure the crop.

**Effects on the Soil.**—Potatoes, being cultivated during the growing season, have about the same effect on the soil as corn. They furnish an opportunity to destroy weeds and conserve moisture. The cultivation aids decomposition or rotting of vegetable matter in the soil, hence this crop exhausts the soil more quickly than grain crops do. If one is to continue to grow potatoes, he must make liberal provision for supplying the soil with plant food. The productivity of a soil is most easily maintained by the rotation of crops and by the application of barnyard manure. In many cases the application of commercial fertilizers to the potato crop proves profitable.

Many of our readers would find it interesting and profitable to become familiar with all of the varieties of potatoes that are doing especially well in their neighborhoods. Notice fields that give large yields, also those that give small yields, and see if you can find out why the different fields did not yield the same.

#### **Questions:**

1. Which of the two crops, wheat or potatoes, yields the larger income per acre?
2. Which of these two crops is the more costly to grow, and why?
3. Which crop is better adapted to small farms?
4. How many bushels per acre should potatoes yield on good, well-prepared soil?

#### **Arithmetic:**

1. An acre of potatoes yields 100 bu. What is the value of the crop at 35c per bu.?
2. It costs \$25.00 per acre to grow potatoes. What is the net profit per acre if the yield is 100 bu. worth 35c per bu.? If the yield is 150 bu., worth 35c per bu.?

3. How many acres of potatoes yielding 100 bu. per acre must be grown to return as much net profit as one acre yielding 150 bu. (cost and price same as in example 2).

#### POTATOES FOR SEED AND COOKING.

**Good Potatoes** are sound, smooth, free from scab, about uniform in size, and when cooked, are white and flaky. There are a great many varieties of potatoes that are good. There is probably no best variety, but the variety that will yield the greatest money value per acre is as a rule the one to raise.

**One Variety in a Neighborhood.**—Potatoes, like many other farm products, sell better when only one variety is offered, and that in large quantities. It is well, therefore, for farmers in a locality to choose one or two varieties that suit them and all raise the same kind or kinds of potatoes. If this is done the potatoes can be sold by the local buyer in car lots of one variety and he can get a much better price, therefore can pay the growers more than he could were each farmer to raise different varieties, thus forcing the dealer to sell mixed potatoes. The following quotation taken from the Minneapolis Journal illustrates the difference in prices that are paid in Minneapolis for mixed and for pure car lots of potatoes: "Potatoes, car lots, Burbanks sacked per bu., 50c; mixed red and white, sacked, 35c; red, sacked, 40c." An increase of five or ten cents in price for potatoes makes quite a difference to the farmer who raises potatoes to sell.

**Seed Potatoes.**—In the fall, when the crop is being dug, is the time to select seed potatoes. If care and judgment are exercised in the selection, the variety may be maintained or improved, while as ordinarily selected a variety tends to run out. Plants may be improved by selection just the same as animals. One of the great laws of the universe is that like produces like. It is desirable to raise large yields of potatoes of medium and uniform size, consequently it is wise to select seed po-

tatoes of that type. If one digs several hills of potatoes and keeps the yields of the various hills separate, he will see that the hills vary in yield and in the size of the potatoes. Some hills have a great many small potatoes, others a good number of medium sized potatoes, and still others have one or two very large potatoes and several small ones.



Fig. 45.—A good hill of potatoes from which to select seed. It contains a large number of uniform potatoes, the kind one likes to raise.

A hill that yields from five to eight potatoes of medium size, with no very small or very large ones, is much more desirable than one which yields an equal bulk of mixed sizes. If one wishes to raise uniform potatoes he should save his seed from hills that produce uniform potatoes. This is impossible to do after the potatoes have been mixed, as one cannot tell from what kind of a hill the seed came. It is not a great deal of trouble to dig several

rows of potatoes by hand, keeping each hill separate, then from the most desirable hills select seed potatoes. This is the surest way known of getting good seed. It is hoped that the readers of this article will observe the variation in potatoes from different hills and save their seed potatoes in the way suggested.

**Result of Cooking.**—Probably no other vegetable is so generally and extensively used as the potato. It is the only one that is served two, and often three times a day the year round. Yet the cooking of potatoes often receives very little thought or attention. There is a vast amount of difference in appearance, taste and

amount of nutriment, between a potato properly cooked and a like potato improperly cooked. Much depends upon the potato itself. Some varieties are never good in certain localities, and some years a good variety yields inferior potatoes owing to the season. But to "show up" potatoes when they are good, and to make the best of poor potatoes by cooking them wisely, is worth while and requires considerable thought and attention. A good potato when properly cooked should be white, dry and flaky, or mealy throughout. It is hoped that the boys and girls will observe the results of proper cooking of potatoes, and try some of the experiments suggested.

**Baked Potatoes** are the most wholesome, as very little nutriment is lost by this manner of cooking. Select potatoes of uniform size, so they will all cook in the same length of time. Wash thoroughly, dry and place in a shallow baking pan which has been heated, and put into a hot oven. The pan is not an essential, however, merely a convenience. The potatoes may be placed on the bottom of the oven. They should bake in forty or fifty minutes. Large potatoes might require an hour. When done, squeeze each until it cracks open, or pierce with a fork, thus giving the moisture a chance to escape, which keeps the potato from getting soggy. (Experiment: leave one potato without cracking or piercing it and compare it when opened with the others.)

**Boiled, Unpeeled Potatoes** rank next to baked potatoes in amount of nutriment conserved. Wash the potatoes, cut a little of the skin from the ends and a narrow band from the center to allow the excess water to pass out. Put potatoes thus prepared into a kettle or stew pan; cover generously with boiling water; put on the cover, and place on a hot stove. They should be kept boiling until they are done, probably twenty-five or thirty minutes. When they have boiled fifteen minutes put in one tablespoonful of salt to every dozen potatoes, and finish cooking in salted water. When done, drain off the water, set kettle back onto the stove and

shake about gently until the moisture has passed off and the potatoes are flaky. (Experiment: let one potato stand for a few minutes in some of the potato water turned off and then open the potato without drying it on the stove. Compare it with the others.)

**Boiled Potatoes (Peeled).**—The most nutritious part of the potato lies near the skin, so pare very sparingly. Then, too, we are often influenced by little things, and if we allow ourselves to be wasteful paring potatoes, we may be wasteful in other respects. Cook the same as unpeeled potatoes. When drying, after they have been drained, more salt may be sprinkled over them. It will help to dry them. (Experiments: take a potato out before it is done and see if it will dry and be flaky. Boil another ten or fifteen minutes too long and note results.)

**Steamed Potatoes.**—Prepare the same as for boiling. Put into a steamer over a kettle of boiling water. Keep this water boiling briskly. Potatoes should be done in thirty or forty minutes.

### Questions:

1. Why is it an advantage for farmers in one locality to raise the same variety of potatoes?
2. What can you say about the selection of seed potatoes?
3. Tell what you can about the different methods of cooking potatoes.

### Arithmetic:

1. Four farmers sell a car load of 600 bu. of mixed potatoes at 38c per bu. How much does each get if they divide equally?
2. Four farmers sell a car load, 600 bu., of uniform potatoes at 48c per bu. How much does each get if they divide equally?
3. A spends 1 day extra in selecting his seed for one acre of potatoes, by the hill. His potatoes yielded 125 bu. per acre. B used any seed he could get. His crop yielded 100 bu. per acre. How much did A make the day he selected his seed, if potatoes are worth 40c per bu.?

## PREPARATIONS FOR A POTATO CROP.

**Good Cultivation Warranted.**—Since potatoes are a side issue on many farms they are often grown without receiving the care necessary to insure a successful crop. A great deal of work is required to grow an acre of potatoes, hence the importance of fitting the soil and caring for the crop so a good yield may be expected. A fair crop of potatoes is worth \$40 per acre. A fair crop of grain is worth \$10.00 per acre. Care in preparing the soil so as to increase the yield 10 per cent means an increase in value of \$4.00 in the potato crop and but \$1.00 in the grain crop. This emphasizes the fact that when a crop that brings a comparatively large income per acre is raised, one can afford to put more expense on fertilizing or preparing the soil or other operations, as cultivating, etc., than when crops yielding less in money value are grown.

**Seed.**—About ten bushels of seed potatoes are required to plant an acre. We learned on page 110 that the best seed potatoes are secured by selecting them from hills in which there are large numbers of uniform and desirable potatoes, rather than from hills with some large and some small ones. Of course such selection cannot be made in the spring. So if one did not make the selection in the fall at digging time, the next best thing is to select good, smooth, uniform, shallow-eyed potatoes from the stock at hand.

It is not wise to plant small potatoes, for it is unreasonable to expect to raise better potatoes than are planted. Very little ill effect will be realized from using small potatoes for a year or so, but if one continues the practice he can but expect to raise small potatoes.

**Prevent Seed from Sprouting.**—Potatoes are liable to begin to sprout as soon as the weather gets warm. This is undesirable, as the spouts take nourishment from the potatoes which should be saved to nourish the young plant when started in the field. Keep the seed in as cool a place as possible without freezing it, and where it is dry. It is a good plan to keep seed potatoes in baskets



or slatted boxes piled up in a cool cellar so the air can circulate freely about them.

**Scab.**—The rough blotches on the surface of potatoes are called scab. It is caused by a disease which attacks the potatoes while they are growing. The disease is caused by certain spores or seeds, just the same as diphtheria or other contagious diseases are caused by germs. To prevent scab the spores of the disease must be destroyed. The spores may live over winter in the soil on which scabby potatoes were grown the year before. They may get into the soil with manure from animals that have been fed scabby potatoes, or they may be on



Fig. 46.—Spreading manure. First operation in getting land ready for potato crop.

the seed planted. The latter is the most common way of spreading the disease, and as the seed is very easily treated to prevent scab there is very little excuse for getting scabby potatoes in this way. Formaline is a liquid which may be purchased at any drug store for from 25 to 50 cents per pint. A pint mixed with 35 gallons of water makes a solution which will destroy the scab spores on seed potatoes if they are soaked in it for two hours. Treat for scab before cutting the potatoes. If cut first, some of the pieces may stick together and the spores in between will not be reached by the solution.

**Cutting Seed Potatoes.**—Experiments have proved that rather good sized pieces give larger yields than small pieces. It is well to cut the pieces to about 1 oz. in size, being sure to get at least one good eye in each piece. The large pieces furnish more food for the plants until they get their roots started than do the smaller pieces.

**Questions:**

1. Why can a farmer afford to spend more time preparing an acre of soil for potatoes than for grain?
2. How should seed potatoes be kept during the winter?
3. How does sprouting injure seed potatoes?
4. How is the disease known as scab spread? How treated?

**Arithmetic:**

1. If potatoes are planted in rows 36 in. apart, with hills 16 in. apart in the row, how many sq. ft. of space will each hill occupy? How many hills will there be on an acre? (There are 43560 sq. ft. in an acre)
2. If there are 10890 hills of potatoes on an acre and one 1 oz. piece is planted in each hill, how many bushels of seed will be required to plant an acre?
3. If there are 10890 hills of potatoes on an acre, how many pounds must each hill yield to give a yield of 300 bu. per acre?

**PLANTING AND CULTIVATING POTATOES.**

**The Soil and its Preparation.**—Potatoes require rich, moist, mellow soil; and, as the tubers must grow under ground to protect them from the sun, it is well to have the soil mellow to quite a depth (about six inches). From this it is evident that the land must be plowed at least six inches deep. Fall plowing is preferable, as it gives the soil a chance to become firm and settled and be acted upon by the weather. Spring plowing, unless very thoroughly disced and harrowed, is liable to be too loose and to dry out. It is also more likely to be lumpy.

**Clover Sod**, or land that has grown clover the previous

year, and was plowed in the fall, is the ideal soil for potatoes, especially if the land was top dressed with manure before it was plowed. A very excellent way to prepare such land is to top dress it with good stable manure in the fall on the clover sod before it is plowed. Then disc it to cut up the sod and mix the manure with

it. Then plow in the fall. This treatment gets the clover sod and the manure well pulverized and mixed together and turned under where the tubers are to grow. This insures them a rich, mellow place. If soil is very light and sandy it would be better to plow the land in the fall without manuring it. Manure it during the winter or spring and disc the manure in, thus keeping it near the surface.

If land has been treated as suggested above, discing and harrowing it a few times in the spring will put it in excellent condition for planting.

If the land has not been prepared in the fall, then the same manuring and discing should be done before

the land is plowed. Then plow, harrow and disc until the soil is well packed down. It is important that spring plowing be well harrowed to assist in firming it, that it may not be so loose as to dry out too quickly.

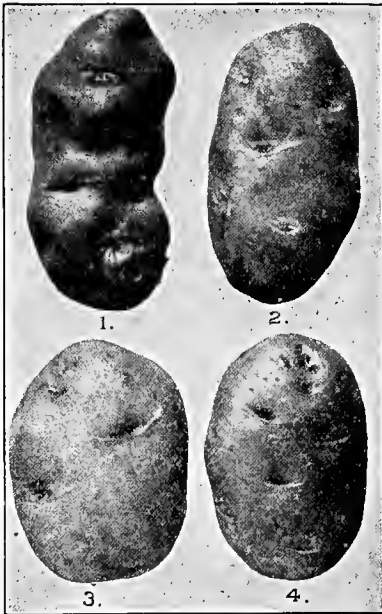


Fig. 47.—Types of potatoes. 1 is a rough, deep-eyed type, not desirable for any purpose. 2. A good type of Burbank. 3. A good type of Carmen No. 3. 4. A good type of early Ohio. Note smooth surface and shallow eyes of Nos. 2, 3 and 4.

**Planting.**—Potatoes should be planted in April or early May, so they will have a chance to grow before the dry, hot weather comes. Potatoes grow better in rather cool weather when the soil is reasonably moist. They are usually planted in rows about 36 inches apart and the pieces are dropped from 14 to 18 inches apart in the row. About 4 inches is a good depth to plant them. If one has a horse planter it is a very easy matter to plant potatoes. There are also satisfactory hand planters. If but one-half an acre to an acre is raised, as is the case on most farms, they may be easily and well planted by marking the land with a corn marker, then plowing a furrow, for each row, with a common walking plow or a shovel plow, dropping the seed in these furrows by hand, then covering with a plow or by harrowing cross-wise.

**Blind Cultivation.**—If potatoes are planted with a hand planter or by dropping into furrows as suggested above, it is a good plan to go into the field with a cultivator after they have been planted a few days and give the plot a good cultivation. This is called blind cultivation. Set the shovels so as to throw the dirt onto the row, thus making a ridge over each row. Follow this every few days by harrowing.

Throwing the dirt in a ridge over the rows, then later leveling it off with the harrow, keeps the soil mellow over the rows and prevents weeds from starting, making it much easier to keep the rows clean.

**Cultivation** of potatoes should continue at frequent intervals, from the time they are planted until the vines cover the ground, to keep down weeds and to check the evaporation of moisture. Potatoes require a great deal of moisture, and a lack of moisture at any time reduces the yield. As in cultivating corn, care must be taken not to cultivate deep enough to injure the roots of the potatoes. Except when the soil is cold and wet, level cultivation is preferable to hilling.

**Questions:**

1. For what reasons would you prefer fall plowing for potatoes?
2. Describe a good method of preparing clover sod for a crop of potatoes?
3. How are potatoes planted? How cultivated?

**Arithmetic:**

1. It costs 35 cents per acre to disc land. A farmer discs his potato field twice after manuring and before plowing. What must be the increased yield to pay for the extra work of discing twice, if potatoes are worth 35 cents per bushel?
2. It costs 50 cts. per acre more to plow 6 in. deep than to plow 4 in. deep. How much does one get for his extra labor if land plowed 6 in. deep yields 10 bu. more than land plowed only 4 in. deep, if potatoes are worth 35c. per bu.?
3. If it costs 50 cts. per acre to cultivate potatoes, how much must each cultivation increase the yield to pay for the cultivation, if potatoes are worth 35 cts. per bu.?

## CHAPTER VII.

### THE HAY CROP.

#### IMPORTANCE OF THE HAY CROP.

**The Hay Crop** bears such an important relation to production of the soil and to the livestock enterprises of the farm, that at least some of the principles of its growth and value should be understood by every tiller of the soil.

**Advantages.**—The value of the hay crop is often under-estimated. In fact, its many advantages are seldom appreciated. Probably you have noticed that it is not necessary to plow and prepare the land for a hay crop as is done for other crops. The grass seed is sown with some preceding grain crop. So seeding of hay costs nothing but for the seed.

If you go out in a good meadow of tame hay at haying time, you will find very few, if any, weeds; and if there are weeds they will be cut with the hay crop before they produce seed, as hay is usually cut before most of the common weeds produce seed. For this reason the hay crop helps to clean the land of weeds.

Another advantage is that a hay crop makes the soil better for succeeding crops, which is not true of grain or corn crops. If there is clover in the hay it adds nitrogen to the soil; and any hay crop increases the amount of vegetable matter in the soil, because it has a heavier root system than have any of the other classes of crops. You can prove this by trying to pull a handful of grass in the meadow and a handful of grain in the grain field.

**Cost.**—There is no other kind of winter feed grown on the farm that can be produced so cheaply in proportion to its feeding value as can hay. Some farmers hesitate to devote much of their land to growing hay, because it seems to bring in less money per acre than do other crops. The fact that it costs much less per acre to raise hay than to raise corn or any of the grain crops, is often overlooked. The following table shows the comparative cost of growing an oat crop and a

hay crop. The figures used are averages derived from keeping accurate records on eight farms at Northfield, Minn., for six years. They are comparatively accurate.

**Cost per Acre, Exclusive of Rent, of Producing Hay and Oats at Northfield, Minn. Average for Six Years.\***

**Hay—Timothy and Clover.**

**First Crop.**

Seed .....	\$ .293
Mowing .....	.368
Raking .....	.178
Cocking and Spreading .....	.199
Hauling in .....	.199
Machinery Cost .....	.548

**Second Crop.**

Mowing .....	\$ .264
Raking .....	.115
Cocking and Spreading .....	.150
Hauling in .....	.464

---

Total Cost ..... \$3.678

**Oats.**

Seed .....	\$ .997
Cleaning Seed .....	.023
Plowing .....	1.256
Dragging .....	.285
Seeding .....	.261
Cutting .....	.401
Twine .....	.335
Shocking .....	.165
Stacking .....	.772
Threshing (labor) .....	.568
Threshing (cash) .....	.774
Machinery cost .....	.517

---

Total Cost ..... \$6.354

The above table shows that there is approximately twice as much labor and expense in growing an oat crop as in growing a hay crop, even when two cuttings of

---

\*Bureau of Statistics Bulletin No. 37.

hay are made. So it is not necessary to get so much from the hay crop as from the grain crop in order to make equally large profits.

**Rotation of Crops.**—If you can find in your neighborhood a timothy and clover meadow seeded last year, and one on similar land that has been seeded down—that is, raising hay for several years—you will see that the new meadow, if a good stand has been secured, will give a larger yield than the old. Likewise a meadow or pasture plowed up will usually raise a larger crop of corn or grain than will a field that has not been in grass for several years. These facts make it evident



Fig. 48.—Newly plowed sod land. The large amount of roots hold the soil together in the furrow.

that both the meadow and the grain and corn crops will yield more if new meadows are seeded each year and old ones plowed for other crops. This means rotation of crops, and illustrates one of the advantages of the practice.

#### Questions:

1. Name some of the advantages of the hay crop.
2. How does the cost of raising oats compare with the cost of raising hay?
3. How does the yield of hay from an old meadow compare with the yield from a newly seeded meadow?
4. What can you say of the rotation of crops?



**Arithmetic:**

1. One acre of clover and timothy will produce 2 tons of hay. How much does it cost per ton if it cost \$3.68 per acre to raise it? How much does it cost per ton if \$3.00 per acre is added for land rent?

2. If hay yields but one and one half ton per acre how much does it cost per ton if it costs \$3.68 per acre to raise it? How much does it cost per ton if \$3.00 per acre is added for land rent?

3. If clover hay is worth \$8.00 per ton compared with bran at \$20.00 per ton, how much is bran worth when clover hay is worth simply the cost of growing it, or \$3.34 per ton?

**CLOVER.**

**Varieties.**—As clover is one of the most valuable field crops, it is important that every one know something of its habits and of the conditions favorable to its growth.

There are several varieties of clover, but only four of the varieties are important in the Central West. These are Mammoth, Medium Red, Alsike and White.

**Mammoth Clover** is very much like medium red. In fact it is very hard to distinguish one from the other. The Mammoth is much coarser than the medium red, and on that account does not make so good a quality of hay. Its chief value is as a green crop to plow under, though it is often used for hay, pasture or seed.

**Medium Red** is easily distinguished from alsike and white clover, as it is larger and each leaflet is marked by a V shaped, lighter colored streak near its center. The red blossoms aid, also, in distinguishing this variety of clover. It will be noticed that nearly or quite all the stems of this clover are covered with fine hair. These hairs are objectionable, as they have a tendency to gather dust, thus making dusty hay, unless very carefully cured. It is usually a biennial, that is, as a rule, it lives but two years. It is usually sown with some grain crop, called a nurse crop. The clover plants are very small during the early part of summer, and do not grow much

until the grain crop is cut. During the fall the clover grows very rapidly; but it does not produce a crop until the next year, the second year of its growth, when it produces two crops—two hay crops or a hay and a seed crop. The second crop is the one usually saved for seed. After the two crops are cut, the plants usually die, as they have lived their life. An occasional plant may live over, and considerable clover may appear in the field the third year; but this is largely due to seeds formed the

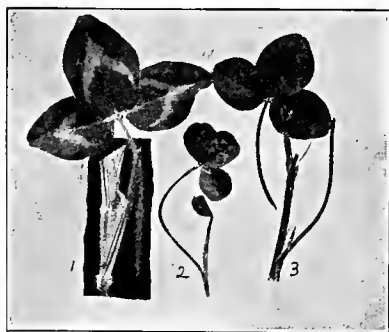


Fig. 49.—Leaves and Stems of Clover. 1. Medium red. (Note markings on leaflets, also hairs on stems.) 2. White. (Note smooth stem and small leaflets.) 3. Alsike. (Note smooth stem and smooth leaflets with prominent midrib.)

first or second year of the clover's growth. This variety of clover is especially adapted to rotation pastures and meadows. Considerable trouble is experienced in curing this variety of hay, as the thick stems contain so much juice that in trying to dry them the leaves, which are very thin, are liable to become too dry and shatter off when the hay is handled.

**Alsike Clover** is smaller than medium red clover, has smaller, more oblong leaves without white markings, and there are no hairs on its stems. The blossoms are smaller and lighter colored, nearly white at first and later pink. The seed is much smaller and darker colored than the seed of medium red. Alsike clover makes a better quality of hay than does the red clover, because it is free of hairs and finer, but, as a rule, it does not yield so much on upland. It is a perennial, that is it lives for several years unless some unfavorable conditions kill it. On this account it is more valuable for permanent pasture or meadow than the medium red. It is quite

well adapted for low wet places as it will stand more water than will the red clover.

**White Clover** is a very small, low growing plant with a tendency to trail along on the ground. It has small,



Fig. 50.—Root Systems of Alsike and White Clover Plants. 1. Alsike. (Note small tap root and comparatively large laterals.) 2. White. (Note creeping stem rooted at different places, and fine fibrous roots.)

nearly round, smooth leaves and smooth stems. The seed is a little smaller than Alsike clover seed and is yellowish in color. It is a perennial. The stems creep along on the ground and take root at the joints, thus starting new plants. It spreads in this way as well as by the seeds. The blossoms are white, and they can usually be seen at any time during the summer from June 1st until it freezes up in the fall. The White clover is of very little value as a hay crop, as it grows too short. It is common on lawns and in old pastures and is a very valuable plant for such places.

**Getting a Catch of Clover.**—Difficulty is sometimes experienced in getting a good catch of clover. As clover grows slowly the first year it is sown, the grain crop with

which it grows is liable to crowd it pretty hard; and when the grain is cut the hot sun is pretty hard on the small plants, especially if the weather is dry. Clover seed should be sown only on a fine, mellow, rich, well-prepared seed bed. Land that has been well manured, then planted to corn and well cultivated, then well disced the following spring, and sown to grain, is in fine condition for clover seed.

If clover seed is sown on poor land the chances of getting a catch are greatly increased if a light dressing of manure can be applied soon after the seed is sown.

**Questions:**

1. Name the four varieties of clover common in the Middle West.
2. Which two are very much alike?
3. Describe the leaf, stem and blossom of each of the last three.
4. What are annual, biennial and perennial plants?

**Arithmetic:**

1. If an acre of clover yields 3500 pounds of hay at the first crop, and a bushel of seed at the second crop, what is the value of the entire crop, hay \$7 per ton and clover seed \$8 per bushel?
2. If an acre of clover yields 200 pounds of seed, what is its value at \$8 per bushel? (60 lbs. per bu.)
3. If clover seed is worth \$8 per bushel, what is its value per hundred weight?

**CLOVER ROOTS AND BACTERIA.**

**Medium Red Clover Root.**—An examination of the roots of medium red, alsike and white clover will show considerable difference in them. The medium red clover has a large tap root (a root running straight down in the soil). This root is much larger and longer than the root of either of the other clovers. If a plant is dug carefully from a well drained soil, this tap root will be found to extend down two, and often more, feet; which shows that this clover gets part of its food from the

sub-soil. It has also many lateral roots running out from the tap root. In fact, if roots are carefully taken up it will be seen that there is nearly as much plant below as above ground. On this account medium red clover is one of the very best crops to grow to add vegetable matter to the soil.



Fig. 51.—Root System of Medium Red Clover Plant. (Note large tap root, lateral roots and nodules caused by nitrogen-gathering bacteria.)

### Alsike Clover Roots

are considerably smaller than those of medium red clover. In many plants the tap root is not plainly seen or is not much larger than the fibrous roots. However the roots of the alsike clover extend into the soil to considerable depth, thus enabling the plants to draw on the subsoil to some extent for plant food. This clover also adds a large amount of vegetable matter to the soil by its roots. Both alsike and medium red are very beneficial to heavy soils, by opening them and letting in air when the roots decay. They are beneficial to sandy soils by adding large amounts of vegetable matter, thus making

the soils capable of holding more moisture.

**White Clover Roots** are very small and fibrous. No tap roots are found, and the fibrous roots do not go nearly so deep as do the roots of the other clovers. The plants grow so thickly, owing to their habit of spreading, that

they thoroughly cover the ground and keep the surface soil well supplied with vegetable matter.

**Clover Adds Nitrogen to the Soil.**—Clover possesses, beside its heavy root system, another feature which makes it a valuable crop to improve the soil. If a clover plant is carefully dug from the soil, small bunches or nodules about the size of an ordinary pin head will be seen on the roots. Fig. 51. These are caused by bacteria. Bacteria are a very low form of plant life. They are unable to live from the soil as higher plants do, but must depend upon plant or animal substances to supply them with organic matter. Disease germs, the germs that cause milk to sour, the germs that cause decomposition or rotting, etc., are also bacteria. Some bacteria live on dead matter, others on live matter. The latter are called parasites. The bacteria causing the nodules on clover roots are in a sense parasites, but in this case they are beneficial; they do something for the clover plant that it is unable to do for itself. All plants require a large amount of nitrogen for food. A very large proportion of the air is free nitrogen. Our common field crops are unable to make use of this nitrogen; but clover, alfalfa, peas, beans and other plants belonging to the family called legumes have the habit, which no other class of plants have, of forming a sort of partnership relation with these bacteria and through them are enabled to draw upon the nitrogen of the air. These nitrogen-gathering bacteria have the power to absorb the nitrogen from the air and to pass it on to the plants on which they are growing. In this way a soil is made richer in nitrogen by growing a legume crop. This is true even though the crop be removed from the field, as the roots and stubble left are rich in this element. An acre of land may contain 150 pounds more of nitrogen after growing a crop of clover than it did before. This is a very important fact to farmers. Nitrogen when bought in commercial fertilizers costs from 16c. to 18c. per pound. A farmer by growing clover or some other legume crop

can add enough nitrogen to the soil to grow several crops of corn or grain, besides getting his legume crop.

**Questions:**

1. Which variety of clover, medium red or alsike, has the heavier root system?
2. In what ways is a clover crop beneficial to the soil?
3. What enables clover and other plants belonging to the same family to make use of the free nitrogen in the air?

**Arithmetic:**

1. What is the value of 150 lbs. of nitrogen at 16c. per pound? (Note: An acre of clover may add 150 pounds of nitrogen to the soil.)
2. How many crops of wheat, each crop removing 25 pounds of nitrogen per acre, are required to use the nitrogen added by a crop of clover?
3. If an acre of clover yields 3500 pounds of hay the first cutting, and 2500 pounds the second cutting, what is the value of the hay at \$7 per ton?

**CURING HAY.**

**The Weather.**—The quality of hay and its value as food depends very largely on the way it is cured. Since hay on a great many farms forms a large part of the winter food for stock, it is important that it be cured in the best possible way. The weather has a great deal to do with the curing of hay, and some seasons it is practically impossible to get hay well cured. But there are certain principles involved that, if followed, will usually result in a better quality of hay than is secured by methods commonly followed. The suggestions given below apply directly to clover, but if followed, will give good results with any heavy crop of hay.

**Time to Cut.**—While hay that is cut when quite ripe yields more per acre and is easier to cure than earlier cut hay, it is much less digestible, less palatable, and contains a smaller proportion of protein, which is the most valuable and costly element in hay. Experiments

show that the greatest amount of digestible food is secured when hay is cut at about the time it is in full bloom. With clover this is usually from about June 15th to July 1st. Never cut hay while the dew is on it, for time is lost in the drying by so doing. The dew will dry off more quickly while the hay is standing.

**Curing.**—If clover is cut in the forenoon of a bright day, it should be turned over, with either a rake or a tedder, before any of the top leaves become dry. The ob-



Fig. 52.—Cock covers in use at the Minnesota Experiment Station in curing alfalfa hay.

ject sought in euring clover hay should be, to keep the leaves green as long as possible, as they help to draw the moisture out of the large stems, which is the difficult part to cure. If it gets dry enough the first day, so a good job of raking can be done, rake it before night: if not, ted it if possible so as to get the green hay from the bottom on top to take the dew, as dew will blacken partially eured clover. If it looks like rain, cock the hay as soon as possible, if not, leave in the windrow. The next morning as soon as the top part of the hay is nearly dry,



rake, or if raked, turn the windrow over either by hand with a fork or with the team and rake. Aim to keep the hay loose in the windrow, so the air can pass through it freely. The leaves are largely protected from the hot sun in this way, and can perform their function of drawing water from the stems, and are not shattered off and lost. It is usually wise to cock the hay the second day if it is too green to store, and leave in the cocks a day or two, then open up cocks for an hour or so to the sun and wind, then put under shelter, either in barn or stack.

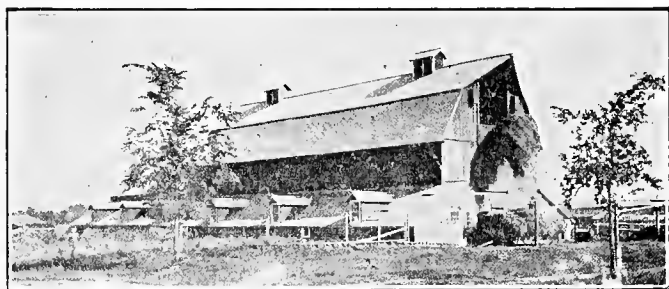


Fig. 53.—The hay sling in operation in unloading hay. Two or three sling loads will take off a large wagon-load of hay and leave very little scatterings.

**Damaged by Hot Sun.**—The old adage, “Make hay while the sun shines,” is good advice, but may be overdone. Hay, especially clover, that has been exposed to the sun for very long is very materially injured, as the thin leaves are dried up and lost and little is left but stems. The heat of the sun is very essential to evaporate the moisture from the leaves and stems. This may be accomplished, however, by curing the hay in the cock or windrow and without allowing the sun to shine directly on the leaves.

**Cock Covers** may often be used with profit. It seems expensive when one first considers them, but if one considers that bran is worth \$20.00 or more per ton and that good clover hay is worth very nearly half as much

as bran for feed, he must acknowledge that the difference in value between good and poor hay is often more than the cost of using covers.

Cock covers are pieces of canvas or sheeting about four feet square, with weights sewed in each corner, so when one is spread over a hay cock the wind will not blow it off. Such a cover helps to protect hay, while curing, from both the sun and the rain.

We would advise our readers to test curing clover largely in the shade, as suggested above, with at least one cock of hay, then compare with other clover cut at the same time but exposed to the sun and dew for two or three days.

If clover is cured until thoroughly dry, and then cocked, it will shed very little water, as the stiff stems stick out in every direction and the water follows them down through the cock. But if hay is cocked when only partly dry, the stems are limber and wilted and so hang down over the sides of the cock, thereby shedding a great deal of water.

### Questions:

1. In what ways may the value of hay be reduced in curing?

2. At what stage of growth should a hay crop be cut? Why?

3. What is gained by protecting clover hay from the sun when curing it?

4. Do you think it will pay to use cock covers in curing hay? Why?

### Arithmetic:

1. If a cock cover large enough to cover 80 lbs. of hay costs 20c., how much will it cost for enough to cover 1 ton of hay?

2. If cock covers can be used five times each year and will last 5 years, how many times can each be used during its life-time?

3. If enough cock covers to cover a ton of hay cost \$5.00 and can be used 25 times, how much does it cost per ton for cock covers?

## CHAPTER VIII.

### FARM MANAGEMENT.

#### THE STANDING OF THE FARMER.

**Qualification.**—To be a successful farmer one must have as much knowledge and ability as has a successful merchant, banker, manufacturer, or any other business man. This fact is now quite generally recognized; but it is not long since people believed that if one was not intelligent enough to do anything else he could farm. This latter belief was true, to some extent, many years ago, when the land was newly settled, the soil was rich, and there was practically no market for anything but wheat, so that the chief requirements of a farmer were to plow, to sow and to reap. The more able farmers were more successful than the others, but even the careless and the thoughtless succeeded fairly well as long as the land was rich and free. These crude and careless methods of farming and the number of farmers who used little system or good business management caused farming to be considered a rather inferior calling. Many who were farming were doing so simply because they could not get out of it, and not because they liked it.

**Conditions Different.**—Conditions are now very different. The fertility of the soil is in many cases somewhat depleted, so that careful and well-planned systems of cropping, tillage and fertilization must be employed to secure good crops. The price of land has increased until one must pay from \$5,000.00 to \$25,000.00 for a 160-acre farm that at one time could be had free. The country is more thickly populated, and systems of transportation are better, so that nearly any product raised can be marketed. The conditions tend to raise the requirements of the farmer. He must be wide awake, intelligent and ever on the alert for better methods of production. Thus the proper management of a farm demands as high a de-

gree of intelligence as is needed in other walks of life, and we now find as strong, as intelligent and as well educated men and women on the farms as in town. On this account no one is now ashamed to be called a farmer. And an intelligent and successful farmer stands as well in any community as does a successful banker, business or professional man.

**Bright Men and Women Seek the Farm.**—The changed conditions are placing more and more bright and progressive men and women on our farms, who are not ashamed to study their profession and to put their best efforts into it. As a consequence we have agricultural schools and colleges, agricultural papers and magazines, and are developing a true science of agriculture. We no longer depend upon "chance" or "good luck" for results in farming, but know the conditions that are necessary to good results and plan and study to supply these conditions. No one is now ridiculed for studying farming; but any boy or girl may well be proud of having been born and raised on a farm and educated for the profession of farming.

### Questions:

1. Why did it require less thought and intelligence to farm many years ago than it does now?
2. Why was farming considered to be an inferior occupation?
3. What has raised farming to as high a degree as any other occupation?
4. What is the result of this good standing for the farmer?

### Arithmetic:

1. In 1870 A took a 160-acre homestead. The land cost him nothing. He built \$300.00 worth of buildings. He had 4 horses worth \$75.00 each, 2 cows worth \$30.00, 2 hogs worth \$7.50 each, 20 chickens worth 25c. each and \$200.00 worth of machinery. How much had he invested? How large an income must he get to pay 6 per cent interest on his investment?

2. In 1910 A's farm is worth \$100.00 per acre; he has \$800.00 worth of horses, \$1,000.00 worth of cattle, \$150.00 worth of hogs, \$50 worth of poultry, and \$1,000 worth of machinery. How much has he invested? How large an income must he receive to pay 6 per cent. interest on his investment?

## ROTATION OF CROPS.

**Definition.**—The rotation of crops means changing the crops year after year on any field, so that no field grows the same kind of a crop for several years in succession.

If a field were sown to wheat one year, barley another year and clover another, we would say that the crops are being rotated on that field.

Good farmers are practicing more or less some plan of crop rotation on their farms, because they have found from experience that their fields yield better if the crops are changed about than when one field raises the same kind of crop for several years in succession.

Larger yields mean larger incomes. Larger incomes enable farmers to have better homes, better schools, better roads; in short, to live better in every way. We should therefore be interested in knowing more about conditions which have a tendency to increase yields.

**Systematic Rotation.**—A still better practice, because it usually results in larger yields and more profit, is to rotate crops in some regular order, so one may know several years in advance what crop will grow on each field. Such a plan of cropping is called a systematic rotation. A very simple form of a systematic rotation is to divide the tillable land into three fields of about equal size and crop them as shown in the following chart:

Field A.	Field B.	Field C.
1909 Oats.	Clover.	Corn.
1910 Clover.	Corn.	Oats.
1911 Corn.	Oats.	Clover.

From the above chart one will see that each field has a different crop on it each year for three years, but that

the farm is producing the same crops each year. That is, one field is in corn, one in oats and one in clover. Corn always follows clover, oats always follows corn and clover always follows oats. If one is practicing such a rotation he can tell, as many years ahead as he wishes, to what crop a certain field will be planted. This enables him to make his plans accordingly. He knows how many acres of corn, oats and clover he will have each year, and about how many bushels or tons he can ordinarily expect. Thus he may provide the proper amount of storage room for his crops. He will know about how much stock he can keep each year, and can have just the amount of machinery he needs.

**Effect on the Soil.**—Another advantage gained by following such a rotation is that each crop leaves the soil in good condition for the crop that is to follow. If the corn crop is well cultivated the oats may be sown the following spring without plowing the land—simply by discing the surface and making a good seed bed. The clover seed is sown with the oats, and makes the crop the year after without extra seeding. Thus three crops are grown and the ground is plowed but once. That is, it is plowed for the corn, grows the corn crop, then a crop of oats and a crop of clover before it is again plowed.

Rotation also helps to keep fields free from weeds. If the corn crop is well cultivated many weed seeds are given a favorable chance to grow, then the next cultivation kills them. The clover crop, as you remember, is cut in the latter part of June, which is earlier than most weeds ripen their seeds. The crop is usually cut again for hay or seed, so weeds are practically given no chance to ripen seed.

All of these advantages are gained simply by having a systematic rotation plan to follow, and without increasing the amount of work. But it does require a little more thought than does a haphazard system of cropping.

**Questions:**

1. What is meant by rotation of crops?
2. What is meant by a systematic rotation?
3. Show and explain the cropping of a farm in a simple systematic rotation.
4. What are the advantages of a rotation?

**Arithmetic:**

1. If but one third of a field is plowed each year if cropped to a 3-year rotation, how much is saved each year on a 90-acre field, if it costs \$1.20 per acre to plow?
2. If it costs \$6.68 per acre to raise a crop of hay and \$9.35 per acre to raise a crop of oats, how much less does it cost to raise 30 acres of hay than to raise 30 acres of oats?
3. If the rotation of crops adds 15 bu. per acre to the corn crop, how much will it increase the yield on 35 acres? How much is the increased yield of corn worth at 35c per bu.?

**CLASSIFICATION OF FIELD CROPS.**

**Three Classes.**—There are a great many different systems of rotation. Some are good and some are not good, and it is well to study a few of the principles of rotation, that we may easily know whether a certain rotation is likely to give good results or not.

We rotate crops in order to get good yields, hence we must know something about the effect of each crop upon the soil, so we may know in what condition the soil will be left for the next crop.

To simplify a study of the general field crops, they may all be placed in three classes, grain crops, grass crops and cultivated crops, basing the classification on the effect each class has on the soil.

**Grain Crops.**—Under grain crops we can place wheat, oats, barley, flax, speltz, millet and other crops that grow but one year from one seeding and are not cultivated while they are growing. This class of crops has a comparatively small root system, and as a consequence very



Fig. 54.—A Grain Crop.

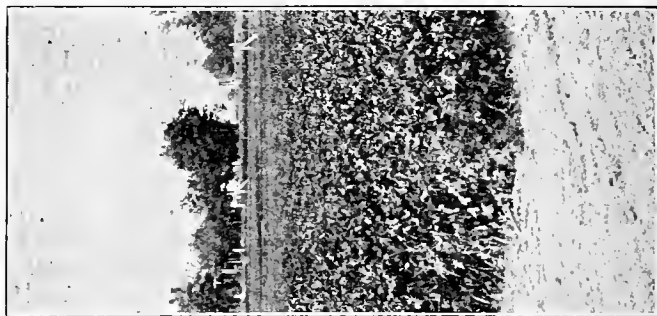


Fig. 55.—Clover, classed as a grass crop.

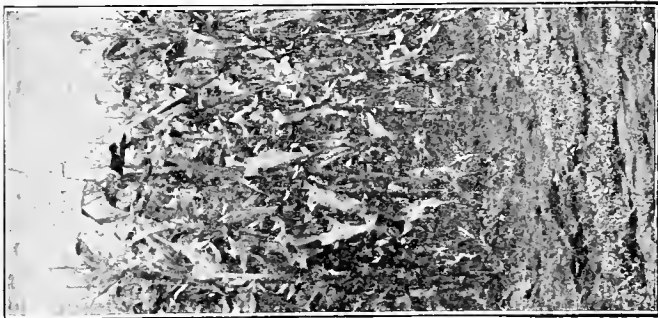


Fig. 56.—Corn, a cultivated crop.



little vegetable matter is left in the soil when the crop is removed. From the time they are sown until they are ripe is usually long enough to allow many of the worst weeds to ripen seeds, so these crops have a tendency to make land more weedy year after year. Grain crops are likely to be sold from the farm, thus removing a large amount of fertility.

**Grass Crops.**—Under grass crops we can place timothy, bromus, blue grass, red top and all the common clovers and alfalfa. These crops are usually used for hay or pasture. They all grow two or more years, and are not cultivated during their growth. They develop heavy root systems, therefore add much vegetable matter to the soil. Grass crops are usually harvested two or more times during the year, and each crop grows so quickly that few weeds have a chance to ripen seed. This crop is usually fed to stock on the farm, and a large part of the fertility removed by the crop is returned in the form of manure.

**Cultivated Crops.**—Under cultivated crops we can place corn, potatoes and root crops; as mangels, beets, etc., or any crop planted in rows and cultivated while growing. The cultivation destroys many weeds, conserves moisture and causes the liberation of plant food; in fact, on very rich soil much more plant food is liberated than is used by the crop, and much is washed out. On this account cultivated crops are much more exhaustive of soil fertility than are the other classes of crops. The corn and root crops are usually largely fed on the farm, hence most of the fertility removed by them is returned in the manure produced.

**A Good Rotation** will usually include one or more crops from each of these three classes. The first rotation mentioned on page 135, wheat, barley and clover, is not a very good rotation, because it includes no cultivated crop to clear the land of weeds and to conserve moisture. The other three-year rotation mentioned, of corn, oats and clover, has one crop from each class and is a very good rotation for many farms.

A rotation is usually called a three, four, five, six or seven year rotation, according to the number of crops included in it.

The kind of rotation suited to any farm must be worked out to provide the grain, feed and pasturage needed on the farm. It is possible to plan a good rotation for any farm; but it requires considerable knowledge and ability to select the very best one. To properly manage a farm requires as much knowledge, ability and judgment as to properly conduct any other business or profession.

### **Questions:**

1. What is gained by classifying field crops?
2. What do you understand by grain crops, and what effect do they have on the soil?
3. What do you understand by grass crops, and what effect do they have on the soil?
4. What do you understand by cultivated crops, and what effect do they have on the soil?

### **Arithmetic:**

1. A bushel of wheat removes 27c. worth of fertility from the soil. How much is removed from an acre yielding 20 bu. of wheat?
2. A crop of clover yielding 2 tons per acre removes 100 pounds of mineral elements worth  $5\frac{1}{2}$ c. per pound. What is the value of fertility sold in two tons of clover hay?
3. A bushel of corn removes 14c. worth of fertility from the soil. How much is removed from an acre yielding 50 bu.?

### **HOW PLANT FOOD IS MADE AVAILABLE.**

**Abundance of Insoluble Plant Food.**—We learned in a previous chapter that plants, like animals, in order to grow must be fed. Plants can make use of food only when it is soluble—that is, when it will dissolve in water as sugar will dissolve in tea. If we think for a minute we will realize that very little plant food in a soluble

form can remain in the soil; because, with the heavy rains we have, a large part of any soluble material present would be washed out of the soil.

Chemists who can analyze the soil and tell of what it is composed have found that there are, in most of our soils, large amounts of the elements needed by plants, but that they are present in an insoluble form. (i. e., they will not dissolve in water). The problem of the farmer, then, seems to be to so manage his fields that plant food will be made soluble while the plants are growing and can use it, before it is washed out of the soil.

**Plant Food Made Soluble.**—The chief method by which plant food is made soluble in the soil is by the decomposition or rotting of vegetable matter. Vegetable matter is any plant or part of plants. Vegetable matter in a cultivated soil is usually roots and stubble of the crops grown and whatever barn yard manure has been applied. In order that decomposition may take place, at least three conditions must exist, and it is very largely to maintain these conditions that fields are cultivated. (By cultivation we mean plowing, harrowing, discing, as well as the work done by cultivators.) The three conditions referred to are a reasonable supply of vegetable matter, and enough heat, air and moisture.

**Vegetable Matter.**—It is evident that vegetable matter cannot decompose in the soil unless it is present. Newly broken fields usually have a good supply of vegetable matter, made up from the accumulated roots, leaves, etc., of the wild plants that have grown there before it was broken. After the land is cultivated the supply is maintained by methods mentioned above.

**Air.**—It would seem that there should be plenty of air present; but if there is too much water in the soil, air is crowded out, or if the soil is too hard and compact, air does not enter it freely.

**Moisture.**—Moisture in the soil comes chiefly from rains, and these the farmers cannot control. Nevertheless, cultivation does much to save moisture. 1st; by

making the soil loose on top, so that any rain that falls readily settles into the soil instead of running off. 2nd, by keeping the surface of the soil loose, moisture does not rise to the surface, hence the sun and wind do not evaporate it so readily. 3rd, by keeping the soil firm from the plant roots down to the subsoil, moisture rises to the roots from the subsoil by means of capillarity. (Capillarity is the force that causes oil to rise in a lamp wick, or coffee to pass up through a lump of sugar when only one side of the lump touches the coffee.)

**Conditions for Decomposition.**—We know from common examples that vegetable matter will not decompose



Fig. 57.—A Crop of Clover Hay. Clover is one of the crops with a heavy root system that adds vegetable matter to the soil.

without the presence of both air and moisture. Fruit in the jar and ensilage in the silo are vegetable matter, and they have moisture; but they do not decompose, because air is kept out. Hay in a mow is vegetable matter, and has plenty of air; but it does not decompose, because it is dry.

When vegetable matter is decomposed the materials of which it is composed are liberated. This liberated material is food for growing plants. If a little air gets in a fruit jar the fruit quickly turns sour. When vegetable matter rots in the soil it also becomes slightly

sour; from this we know that it gives off acid (or something sour), and this acid helps the water in the soil to dissolve some of the mineral materials off of the soil particles. Thus, not only is the material of which vegetable matter is composed liberated by decomposition, but some of the insoluble mineral plant-food is made soluble and available as food for growing plants.

### Questions:

1. Why cannot much soluble plant food remain in the soil?
2. What is the farmer's problem in regard to soluble plant food?
3. What is the chief method by which plant food is made soluble?
4. What forms the vegetable matter in a newly cultivated field? In an old field?

### Arithmetic:

1. A bu. of wheat contains  $1\frac{1}{4}$  lbs. nitrogen (N),  $\frac{5}{8}$  lb. phosphoric acid ( $P_2O_5$ ) and 1-3 lb. of potash ( $K_2O$ ). How many pounds of each element are removed from the farm when 20 bu. of wheat are sold?
2. A bu. of corn contains 2-3 lb. of N,  $\frac{1}{4}$  lb.  $P_2O_5$  and  $\frac{1}{4}$  lb. of  $K_2O$ . How many pounds of each element are removed from the farm when 40 bu. of corn are sold?
3. Average stable manure contains .51% N, .41%  $P_2O_5$  and .51% of  $K_2O$ . How many pounds of each element in 1 ton of manure? In 8 tons?

### ROTATION MAINTAINS VEGETABLE MATTER.

**Worn-out Farms.**—One often hears the remark that a certain farm is worn out or exhausted. The remark is usually based on the fact that the farm in question no longer yields good crops. Many farms that formerly yielded from twenty to thirty bushels of wheat per acre now yield but from five to ten bushels. When we consider the fact that some of the land in Europe has been cultivated for centuries and is still producing large yields, we must conclude that land in the old world is much

better, or that farms in this country that are giving such low yields are not exhausted but are simply not in good condition.

Our faith in the latter conclusion is strengthened by the fact that most of us know of instances where men have taken these run-down farms, and after a few years have been able to get as large yields from them as ever.



Fig. 58.—Spreading manure. Adding vegetable matter and plant food to the soil. Manure is spread much more evenly and more easily with a manure spreader than by hand.

From the facts at hand, we must conclude that very likely the reason these farms are at present unproductive is because conditions are not favorable for the liberation of plant food. That is, the plant food may be present, but is not soluble so plants can get it easily. On page 141 we learned that the most common way in which plant food is made soluble is by the decomposition of vegetable matter. This leads us to believe, then, that the reason many farms are unproductive is because some of the conditions necessary for decomposition are lacking.

**Lack Vegetable Matter.**—The condition we are most likely to find lacking in these unproductive soils is a sufficient supply of vegetable matter. A good rotation of crops provides for maintaining the supply of vegetable matter in the soil, because it provides that each field shall grow a grass crop one or more years in every three to six years. Grass crops have heavy root systems and therefore add vegetable matter to the soil.

One can get a good comparison of the amount of vegetable matter added by grain crops, and by grass crops, by going into the field and pulling a few of the stubbles of grain and of clover and timothy. One will find that the grain stubble is pulled up very easily and that some digging must be done to get stubble of any of the grass plants. (Try this.)

In the simple three-year rotation, corn, grain and clover, discussed on page 135 you will see that each field will be in clover once every three years. This will add sufficient vegetable matter to keep the soil reasonably well supplied during the other two years while the corn and grain crops, or crops that exhaust the vegetable matter, are growing.

**Cultivated Crops**, as corn, probably return as much vegetable matter to the soil in the roots and stubble as do the grain crops, but they use during their growth a great deal more than do the grain crops, because of the cultivation given them. We have learned that moisture and air are essential to decomposition. By the cultivation of these crops the soil is loosened on top, so air can enter freely and so moisture does not rise to the surface to evaporate, as it does in a grain field that is not cultivated while the crop is growing. Thus the two essentials to decomposition, air and moisture, are maintained, consequently decomposition is more rapid and more of the vegetable matter is decomposed.

A rotation which provides for growing grass on one third of the tillable land furnishes a great deal of pasture and hay, which usually is an incentive to keep more

live stock. Hence more manure is produced than is usually available on a grain farm. More manure can be applied to the fields; and this, too, has a marked effect in keeping up the supply of vegetable matter.

**Questions:**

1. What is generally lacking when a soil ceases to be productive?

2. In what ways does the rotation of crops tend to increase the supply of vegetable matter in the soil?

3. How can you prove that grass crops add more vegetable matter to the soil than do grain crops?

**Arithmetic:**

1. It costs \$9.16 per acre to grow a crop of oats. How much will it cost to grow 33 1-3 acres of oats?

2. It costs \$11.66 per acre to grow a crop of corn. How much will it cost to grow 33 1-3 acres of corn?

3. It cost \$6.18 per acre to grow a crop of mixed hay. How much will it cost to grow 33 1-3 acres of mixed hay?

4. It costs \$9.86 per acre to grow a crop of wheat. How much will it cost to grow 100 acres of wheat?

5. Using the figures given in the preceding examples, how much more does it cost to grow 100 acres of wheat than to crop 100 acres in a rotation with 1-3 in corn, 1-3 in oats and 1-3 in hay?

**PLANNING FARMS.**

**Farm and Farmer.**—In the last few pages we have learned something about the rotation of crops, its effects on the soil, and how to tell whether or not a certain rotation would be likely to keep the soil in good condition and give good yields. Before we can plan a suitable rotation for any particular farm we must know certain facts about the farm and the farmer.

**Sketch of Farm.**—We should have a rough sketch of the farm in question, showing its shape and size, the location of the farmstead (farmstead includes buildings, yards, orchards, garden, drives and lawn) the size and



shape of the fields and pastures, the fences and lanes and the sloughs and waste places. We should know also the kind of soil, the location of the farm, the amount and yields of the different crops grown, the markets, and the ability and desires of the farmer.

**The Farmstead.**—The location of the farmstead determines the distance each field will be from the base of operation, the distance live stock will have to go to pasture on the different fields, the amount of lane necessary to get them there, and whether or not they must be driven across a public road or a railway track.



Fig. 59.—It costs much more per acre to plow a small irregular field like the above, than a long field as shown in Fig. 60.



Fig. 60.—Plowing a long, regular field. Compare with Fig. 59. Which field would you prefer to plow?

**The Size and Shape of the Fields** will determine the size and kinds of machines that may be used and the type of farming to be done. If there are only a few small and irregular fields one cannot grow grain to advantage and compete with farmers who have large, straight, level fields. On the few small fields the farmer would need to grow some crop he could care for to advantage with small machines, and he would also want to grow some crop that would bring in considerable per acre. Five or ten acres of grain or corn would not bring in an income large enough to support a family, but five or ten

acres in small fruit or vegetables would produce products of sufficient value to make a good income and provide labor for a fair-sized family.

**Fencing.**—The amount of fencing on a farm and the cost per acre of fencing the various fields are factors which would influence one in deciding on the kind and amount of live stock to be kept.

**Waste Land**, or land which for some reason cannot be cultivated with the regular fields, must be considered in planning a rotation. If there is any considerable amount of such land that can be used only for hay or pasture, stock must be provided to utilize this feed, and very likely a smaller proportion of the tillable land would be needed for hay and pasture, so that a correspondingly larger acreage could be devoted to other crops.

**The Soil and the Location** determine the kind of products that can be raised and the kinds desirable to raise. One must not plan a rotation providing for a large acreage of corn, in a community or on a soil not adapted to corn production. Likewise it would not be well to plan to raise a heavy bulky crop, like potatoes, where one is a long distance from market, or to plan to keep dairy stock where facilities are poor for marketing dairy products, or to plan to keep a lot of beef stock or hogs where grain feed, as corn or barley, is difficult to grow.

**The Acreage and Yields** of the different crops that have been grown are good indications of the type of farming carried on in the community, the condition of the farm and the kind of farming with which the owner is familiar and best adapted to do.

**The Ability and Desires of the Farmer** are probably the most important consideration of all. If a man does not like live stock or a certain kind of farming, it is very likely he will not succeed with it, though the plan of managing the farm might be excellent. Likewise a farmer might have considerable ability as a market gardener or in raising horses or sheep, but might fail at dairying or general farming.

**Questions:**

1. What are some of the facts we should know about a farm to enable us to plan a suitable rotation?
2. What does the location of the farm determine?
3. What should the size and shape of the fields determine? The amount of fencing? The waste land? The soil and location? The size of the farm and yields?

**Arithmetic:**

1. If one raises 10 acres of wheat yielding 20 bu. per acre, how much is his crop worth at 67c. per bu?
2. If one raises 10 acres of potatoes yielding 150 bu. per acre, how much is his crop worth at 35c. per bu?
3. If one raises 10 acres of onions yielding 400 bu. per acre, how much is his crop worth at 50c. per bu.?

**ARRANGEMENT OF FIELDS.**

**A Map.**—If one were to make a map of the average farm, showing all of the fields as the farm is cropped for one year, he would likely be surprised at the number of fields and their irregular shape. Often a little careful planning will result in a great saving of time and labor.

**Fields for a Rotation.**—If the rotation of crops is to be practiced, the farm must be divided into as many fields as there are years in the rotation or rotations. To do this in a way to be most economical of fences and to get the fields properly located, necessitates a careful study of conditions. In arranging the fields on any farm it is desirable to (1) Have fields of uniform size. (2) Have fields of convenient shape to work. (3) Have one end of each field as near to the farmstead as possible. (4) Economize in fencing. (5) Make the best use of all parts of the farm.

**Uniform Size.**—Fields should be of uniform size to make the farming business systematic, so a like amount of various crops may be grown each year. This regulates the amount of labor and machinery needed and live stock that may be kept, and makes possible a really systematic arrangement of the farm business.

**Shape.**—As a rule long fields are more desirable than square ones, as machines can be used on such fields to

better advantage, but at the same time this must not be overdone, especially if the fields are to be fenced, for long fields require more fencing per acre than do shorter ones.

**Distance from Farmstead.**—A great many trips must be made each year to each field and a difference of several rods in distance from the farm buildings makes a great difference in a year or in a lifetime. Figure 61 illustrates a 160-acre farm in Dakota County, (a) as the fields are now arranged, and (b) as they very likely

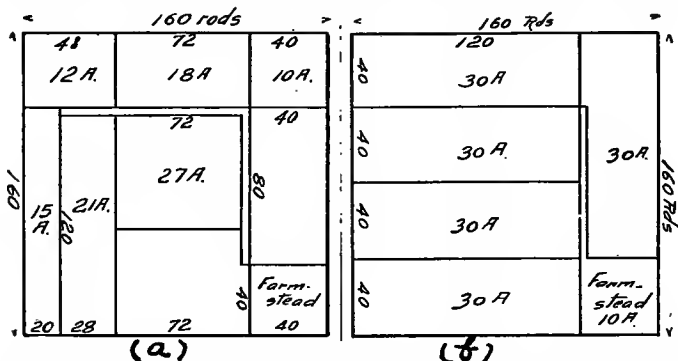


Fig. 61.—A 160-acre farm. (a) Fields poorly arranged. (b) Fields well arranged. Note amount of fencing required to enclose all fields in (a) and compare with (b).

will be arranged when a systematic rotation is adopted. The whole of this farm is tillable. A study of these two plans shows that by the re-arrangement of fields there would be a saving of 252 rods of fencing if all fields were to be fenced. In the new plan, the fields are of excellent shape to work, are all the same size, and the average distance of the fields from the farmstead is 24 rods, while in the old plan the average distance to the fields is 70 rods.

**Economize in Fencing.**—The size and shape of fields have much to do with the amount of fencing required to enclose an acre. Fig. 62. (See Arithmetic lesson on next page.)

If one wishes to divide an 80-acre farm into 5 fields of equal size, there is room for study. The proper solution may mean quite a saving in fencing and in operating the fields. The three plans a, b, and c, in Figure 62, illustrate three ways of dividing an 80-acre farm into five equal sized fields. An 80-acre farm is usually 80 rods wide and 160 rods long. If it is divided as shown in (a), 640 rods of fencing would be required for the inside fences. If divided as shown in (b), 448 rods would be required, and if divided as shown in (c) only 426 rods would be required.

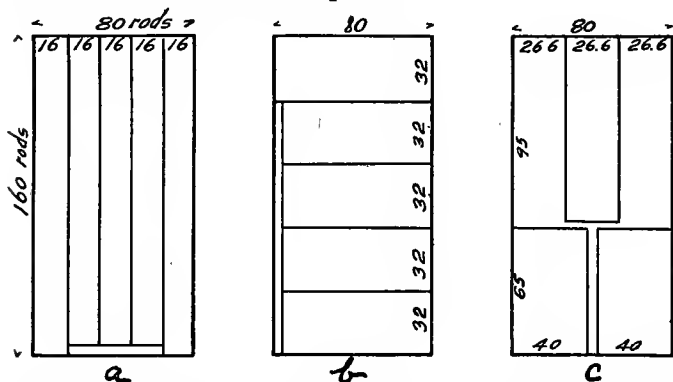


Fig. 62.—An 80-acre farm divided into five fields in three different ways. Figure the amount of fencing required to enclose the fields in each case.

### Questions:

1. What are the advantages of having fields uniform in size if one practices a rotation of crops?
2. Can a farm be so divided as to make any difference in the average distance of fields from the farmstead?
3. What effect does the shape of fields have on the amount of fencing required per acre to enclose them?

### Arithmetic:

1. How many acres of land in a field 1 rod wide and 160 rods long? How many rods of fencing are required to enclose it? (160 square rods in an acre.)

2. How many acres in a piece of land 16 rods by 10 rods? How many rods of fencing are required to enclose it?

3. How many acres of land in a field 40 rods square? How many rods of fencing are required to enclose it? How many rods of fencing are required per acre?

4. How many acres in a field 80 rods square? How many rods of fencing are required to enclose it? How many rods of fencing per acre?

### A PRACTICAL ROTATION.

**Application.**—To apply the principles of crop rotation and farm planning to an actual farm, we will study one on which a good system of rotation has been practiced for several years.

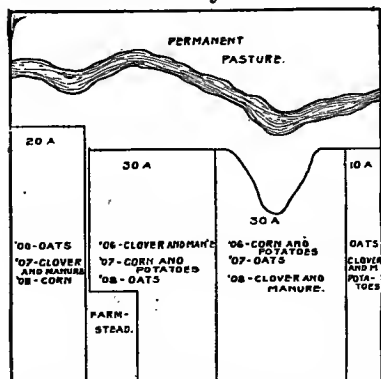


Fig. 63.—The 160-acre farm owned by C. E. Brown, Elk River, Minn., on which a three-year rotation has been successfully followed for a number of years.

**The Farm** we will take is a 160-acre farm, one and a half miles from Elk River, Minn. The soil is light, sandy loam. The owner, Mr. C. E. Brown, specializes in growing potatoes and live stock. He is a very careful farmer, so a study of his methods and of his farm will be valuable.

The accompanying chart, Fig. 63, shows the lay of the farm and the arrangement of the fields. Nearly half of the farm, the back part, is broken up by the river and bluffs so it is not tillable and can be used only for pasture. The balance, or 90 acres, is all well drained, reasonably level and easily worked.

**The Rotation.**—The 90 acres of tillable land is divided into three 30-acre fields, or rather two 30-acre fields and

a 10 and a 20-acre field. These two smaller fields are farmed as though they were only one field; so they make the third 30-acre field. One field raises grain, one field raises clover and one field raises corn and potatoes each year, but no field grows the same kind of a crop two years in succession. For example, the field to the right of the farmstead produced clover in 1906, corn and potatoes in 1907, and oats in 1908.

**The Potato Crop.**—The chief field crop that is raised for sale on this farm is potatoes, so the whole farm is planned to give good crops of potatoes. The first crop of clover is cut for hay. Sometimes the second crop is cut for seed, but more often it is plowed under to add plant food for the potato crop which is to follow. All of the manure made on the farm is also applied to the clover land, thus making an ideal place for potatoes. The clover and manure have made the land rich and the clover crop has aided in cleaning it of weeds. The potatoes have a clean, rich soil in which to grow.

**Corn.**—Only a part of the clover sod plowed up is planted to potatoes. The balance is planted to corn. The corn and potatoes are considered as one crop in the rotation, since they are both cultivated crops and have about the same effect on the soil. For years Mr. Brown has been ambitious to raise 100 bu. of corn per acre. He has not quite reached that yield yet, but probably will. He gives his corn land the same careful preparation that he does his potato land, and consequently gets good crops.

**Oats.**—After he has grown his crop of corn and potatoes he wishes to get his land seeded to clover again, because he has found that clover is the best crop he can raise to get his land in good condition for corn and potatoes again; besides, he needs the clover hay for his cows. As clover must be sown with a grain crop, he seeds this corn and potato land the following spring to oats. With the oats he sows clover and timothy seed, which make his crop the year after the oats are harvested.

**Clover.**—Getting a catch of clover is the key to Mr. Brown's success as a farmer, so he takes every precaution to be sure of a stand. The cultivation given the corn and potatoes saves moisture, and the manure and clover in the soil give up plant food, so there is more moisture and plant food in such land the following year than there would be if the field had been pastured or had grown a crop of grain. This extra moisture and plant food help to start the clover seed that is sown with the oats the year after the land grows corn and potatoes.

**Results.**—That this kind of farming pays is shown by results. Besides good crops of clover, corn and oats, the potato crop on this farm brought nearly \$100.00 per acre in 1908 and \$60.00 per acre in 1909. As it cost Mr. Brown about \$30.00 per acre to raise potatoes it is plain that he has made a profit on these crops.

**Questions:**

1. What is the rotation practiced on the farm discussed above?
2. How is the land prepared for potatoes?
3. What crop follows potatoes and corn in this rotation?
4. What crop follows the oat crop, and when is it seeded?

**Arithmetic:**

1. If Mr. Brown raises 15 acres of potatoes each year, how many bushels will he have if the yield is 165 bu. per acre?
2. If Mr. Brown raises 15 acres of corn each year, how many bushels will he have if the yield is 50 bu. per acre?
3. If oats yield 48 bu. per acre, how many bushels will 30 acres produce?

**A FIVE-YEAR ROTATION.**

**Re-arrangement of a Farm.**—A 160-acre farm in southeastern Minnesota, four miles from a good milk market was cropped in 1904 as shown in Fig. 64. This farmer was carrying on general diversified farming,



and without changing the type of farming in the least, his farm was replanned and a systematic rotation of crops arranged, that would certainly make the farm more attractive, more easily worked, and more productive if put in practice. In Fig. 64 note the small and irregular fields, the distance some of them are from the farmstead, and the lack of system in cropping.

Without materially changing the amount of land devoted to each kind of crop this farm may be re-arranged in five uniform fields of convenient shape and size (27 acres each) and one end of each field be as near to the farmstead as is easily possible on such a farm. (See Fig. 65.) The 12-acre field in the southwest corner is too wet to cultivate, so is left as permanent meadow.

**Rotation.**—A five-year rotation would be well adapted to such a farm, as it would provide about the same amount of hay and pasturage as was formerly used. This rotation would be corn, grain, meadow and pasture. That is, one field would produce corn, two fields would produce grain, one would produce hay and one would produce pasture each year. The field that grows corn the first year would produce grain the second and third years, meadow the fourth year, and pasture the fifth year.

**The Grain Crops.**—The first grain crop after the corn would be sown on the corn land, usually without plowing, but simply disking it well so as to make a good seed bed. After this grain crop was harvested the land would be plowed in the fall, so it would have time to settle down and become compact by spring. The next spring it would be sown to grain again, but with the grain grass seed, timothy and clover, would be sown to make the crop for the two years following.

**Meadow.**—We have learned that grass crops as meadow and pasture are beneficial to the soil, as they clean it of weeds and add vegetable matter. This rotation provides for having each field in grass two years out of five. The first year the grass would be cut for hay and the second year it would be pastured.

**Pasture.**—Pasturing land occasionally, as provided in this rotation, is beneficial to the soil, as practically all of the crop grown during the year is left on the field as manure, and the development of the roots adds vegetable matter also. Pasturing usually puts land in good condition for other crops. One can drive into a pasture at any time during the summer; so it is an excellent place to haul manure when the other fields are growing crops. This manure plowed under with the pasture sod makes a good seed bed for corn.

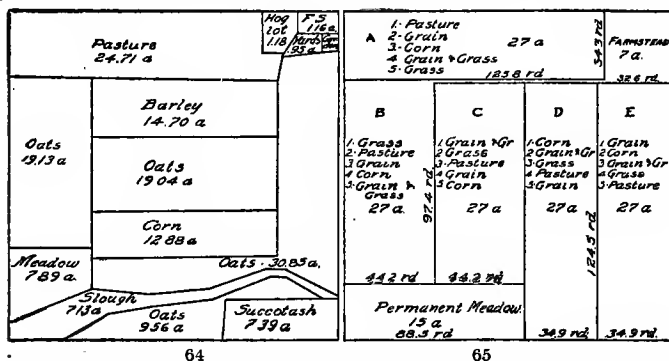


Fig. 64.—A 160-acre farm in southeastern Minnesota, cropped in 1904. Compare with the re-organized plan in Fig. 65.

Fig. 65.—The 160-acre farm re-organized for a five-year rotation. Note convenient shape and arrangement of fields, and that there is little change in the acreage of crops grown. The fields are simply arranged better and a systematic rotation planned. Compare with Fig. 64.

**Corn.**—In this rotation corn is planted on manured pasture sod each year. This is a very desirable place for corn, and usually results in good yields.

We wish each reader would carefully study the accompanying charts and, if possible, draw them and put in the crop that would be grown on each field each year. This will aid you in thoroughly understanding this rotation. The figures 1, 2, 3, 4 and 5 indicate the 1st, 2nd, 3rd, 4th and 5th years of the rotation. You will observe that each crop is produced each year.

This five-year rotation is a good one for many farms, and every farm boy ten years old and over should thoroughly understand it and its advantages over no rotation.

Such a rotation tends to keep the fields clean of weeds, productive, and to economize labor. Each field is plowed but twice in five years and seeded but three times in the five years. Still it is kept in good condition for the crop it is to grow. This is because the crops are so arranged that each crop aids in fitting the soil for the crop that follows.

**Questions:**

1. What is the five-year rotation described above?
2. If one had five 20-acre fields cropped to the above 5 year rotation, how many acres of grain would he raise each year? How many acres of corn? Of pasture?
3. In what ways does the five year rotation described above aid in cleaning the land of weeds?

**Arithmetic:**

1. If a farmer on the above 160-acre farm kept 15 cows, 8 two-year-olds, 10 yearlings and 12 calves, how many head of cattle would he have?
2. If each cow required 1 acre of pasture for the summer, each two-year-old  $\frac{3}{4}$  acre, and each yearling  $\frac{1}{2}$  acre, how many acres of pasture would be needed?
3. If each cow required, during the winter,  $2\frac{1}{2}$  tons of hay, each two-year-old 2 tons, each yearling 1 ton, and each calf  $\frac{1}{4}$  of a ton, how many tons of hay would be needed?
4. If the 27 acres of rotation meadow produced two tons per acre, and the 12 acres of permanent meadow produced  $1\frac{1}{2}$  tons per acre, how many tons of hay would the farm produce?

**FARM ACCOUNTS.**

**Bookkeeping.**—One of the first essentials of successful farm management is a set of accounts that will show which enterprises are paying and which are not. To keep a complete set of books for all the enterprises on a farm requires considerable time and training, but most any

farmer or boy or girl can, with little effort, keep a reasonably accurate account of one or more of the leading enterprises on his own farm. We hope our readers will take up some of the problems presented in the next few pages and apply them to their own farms. We are sure they will feel well repaid for the time spent. We will not try to give a complete system of farm bookkeeping, as too much space and study would be required, but we do wish to study with our readers some of the problems of farm management affecting a few of the more general

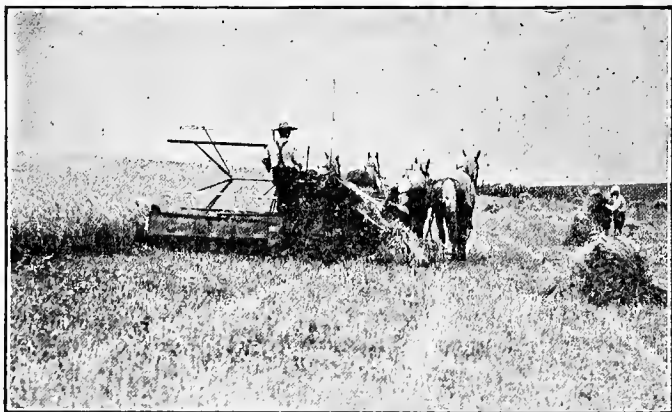


Fig. 66.—Harvesting Grain. One should be able to answer the following questions: How much does it cost per acre to harvest grain? To shock it? To stack it? To thresh it? What is the total cost per acre to produce a crop of grain?

enterprises of the average farm, and to show the application of accounts and figures to farming as a business, and the value of their use.

**Enterprises.**—Some of the main enterprises on the general farm are: Horses, Cattle, Sheep, Hogs, Poultry, Fruit, Grain, Hay, or, in short, any of the various classes of products produced. If one keeps only a cash account showing the receipts from products sold and the amount spent, while he might make a profit on the whole

farm, he might lose on sheep, hogs or some of the other enterprises, and not know it. If he had an account with each enterprise, he would know on which he was losing and on which he was making a profit, and could plan his future work so as to increase the profitable lines and decrease or improve the unprofitable ones.

**The Farmer as a Merchant.**—The farmer buys and sells products just as truly as does the merchant. The way he buys most of the products he sells is somewhat complicated; so he seldom knows, unless he keeps accounts, just how much any particular thing, as a hog or bushel of grain, has cost him. The cost of a product of the field to a farmer includes rent on land, seed, man and horse labor in preparing the land, seeding, cultivating, harvesting, machinery cost; also any cash expenditure, as for twine, oil or threshing. The cost of a live stock product includes labor, feed, shelter, interest on investment and depreciation. It is not at all difficult to keep a fairly accurate account of some of the leading enterprises, and it gives one a much better grasp of his business than he can get in any other way.

**Land Rent.**—Land rent is one of the items of cost in crop production that must be considered. This cost is very evident if one does not own the land, but pays rent for the use of it. If one owns land himself he must charge a fair rent per acre against each crop, because he expects his money invested to be worth a certain rate of interest. That is, he could loan his money at a fair rate of interest were it not invested in the farm. If one did not consider rent as an item of cost against each crop he might apparently make a profit in his farming operations while in reality he was losing—that is, growing crops at a loss, but making more than wages on his labor because of the income on his investment. If such were the case he might be better off to sell his farm and loan his money to some one at 5% or 6% interest.

### Questions:

1. For what reasons is it advisable for a farmer to keep accounts?

2. In what way does a farmer buy the hogs, milk, etc., that he sells from the farm?

3. Why is land rent one of the items in the cost of production, even though a man may own his land?

**Arithmetic:**

1. If a farmer feeds a cow each day for 200 days, 25 pounds of hay worth \$5.00 per ton and 6 pounds of grain worth \$20.00 per ton, what is the cost for feed for the 200 days?

2. If pasture for a cow is worth \$1.00 per month, what is the cost of pasturing a cow 165 days?

3. If  $\frac{1}{2}$  hour per day is required to care for a cow during the 200 days she is kept in the barn, and  $\frac{1}{4}$  hour per day for the 165 days she is pastured, how many hours of labor are required to care for a cow a year? What is this labor worth at 12c. per hour?

4. What is the total cost of feed and labor for the cow for the year? How many pounds of butter-fat must she give in the year to pay for these items if butter-fat is worth 28c. per pound?

**LIVE STOCK ACCOUNTS.**

**Making Work Interesting.**—Nearly every farm boy, while he is attending school, has more or less work with the stock at home. This work done mornings and evenings, often under unfavorable conditions, is sometimes uninteresting to say the least, though it is as valuable a part of one's education as are the things one learns at school. Keeping records with the various classes of stock, so one knows which class is giving the best returns for feed and the highest price per hour for labor, adds to the work an interest that can be gained in no other way.

In order to know the profits or losses of an enterprise, certain charges must be made and deducted from the value of the product. The main charges against live stock are: depreciation, interest on investment, feed, labor, shelter.

**Depreciation** is the difference between the value of any property at the beginning and at the end

of the period during which an account is kept of it. For example, if one has ten cows at the beginning of a year worth \$400, and at the close of the year they are worth less or he has lost or sold some, so that the total value of cows on hand is but \$350, there will have been a depreciation in value of \$50, which must be accounted for in the charges against the stock. Likewise there may be a gain in the value of the stock for a given period. If so, it must be credited to the enterprise. This loss or gain is most easily accounted for by taking an inventory at the beginning of the year—that is, making an estimate



Fig. 67.—A fine bunch of hogs. The questions one should be able to answer when he has produced a lot of hogs are: How much did they cost per pound? How many pounds of corn or other feed did it take per pound of pork, etc.

of the value of the stock on hand and charging the enterprise with this amount, then crediting the enterprise with the inventory value at the close of the year.

**Interest on the Investments** must also be charged against an enterprise if an accurate knowledge of loss or gain is to be had, because if the money invested in stock were loaned it would earn a certain rate of interest. One would not care to invest money in stock if he could

not get as much interest on it as he could obtain for it if invested in some other enterprise. A very common rate of interest is 6%. Thus if one had \$400 invested in live stock for a year, one of the charges against the stock would be an interest charge of \$24, as that is the amount \$400 would earn if loaned at 6%.



Fig. 68.—Scales and a Convenient Case for Weighing and Sampling Milk.

**Feed.**—The value of all feed consumed must be charged to the stock. This is usually the only charge considered, but it is evident that the other items mentioned are as legitimate charges. It seems at first thought that it would be difficult to keep account of the amount of feed fed to each cow or to all the cows, but very little time is required to get approximately the amount fed for a month. If one carefully weighs, for a few days, the hay and grain that he feeds, he can soon learn to feed about the desired amount without weighing, but simply by using the same measure

for grain and giving about the same sized forkful of hay or the same number of bundles of fodder. When one knows about the amount of feed fed per day, he can get the amount fed per month by multiplying by the number of days in the month.

**Labor** or any work done in caring for any class of live stock or marketing the product must be charged against the enterprise, because if one hires the labor he



must pay for it, or if he does the work himself he wants wages, as there is little satisfaction in caring for live stock for nothing. By giving the matter a little thought for a few days, one can determine about the amount of time required each day to care for any class of live stock; and by multiplying the amount by the number of days in the month, can get the amount of work done in the month.

**Cost of Shelter** is not so easy to determine; yet it is an actual cost against the live stock. An easy way to get the approximate cost for shelter, is to find out the value of the building or part of the building in which the stock is kept, then figure 8 per cent of this value as the annual cost of shelter. The 8 per cent will allow for interest, insurance, taxes, repairs and depreciation.

**Questions:**

1. What will add an interest to caring for stock?
2. What are the main charges to be made against live stock when keeping an account?
3. Explain each charge.

**Arithmetic:**

1. On Jan. 1st 1909 a barn is worth \$1000.00. On Jan. 1st 1910 it is worth \$950.00. How much has it depreciated in value? How long will it last if it depreciates the same amount each year.
2. If a cow is worth \$50.00 and lives ten years, what is her annual depreciation?
3. If a barn that shelters 40 head of stock costs \$2,000, how much is the annual cost of shelter if one figures 8% on value of barn? How much is the annual cost of shelter per animal?

AN ACCOUNT WITH A COW.

**Actual Figures.**—To simplify the account with the dairy stock and to illustrate what any boy may do at home with some cow he is milking and caring for, we will use a record which shows the average results per cow for the year 1908 in a herd of 14 cows of which an accurate record was kept.

### A Business Statement Showing the Cost and Income of One Cow for the Year 1908.

	Dr.	Cr.
Int. on investment at 6% .....	\$ 2.40	
Value of grain fed .....	10.46	
Value of roughage fed .....	12.29	
Value of pasturage .....	5.00	
Cost of labor .....	23.28	
Cost of shelter .....	3.20	
Miscellaneous expense .....	1.50	
<b>Net profit .....</b>	<b>.43</b>	
Income for year .....		58.56
		<hr/>
		\$58.56 \$58.56

(Note.—The 43c. net profit was obtained by deducting the sum of the seven items of expense, \$58.13, from the \$58.56 income).



Fig. 63.—Weighing hay. If one weighs hay a few times when feeding he will soon be able to tell approximately how much he is feeding without weighing it every time.

The above is a complete business statement except for the opening and closing inventory. These were left out to simplify the account. To put them in, one would simply put in the debit column the value of the cow at the beginning of the year and in the credit column her value at the close of the year.

**Interest on Investment.**—To get this item we simply assumed the cow to be worth \$40.00 and figured 6% on this amount.

**Feed.**—The cow was fed in the stall for seven months, during which time she ate 301 pounds of farm grain and 442 pounds of mill feed, worth \$10.46, and 1,496 pounds of

hay and 3,330 pounds of fodder, worth \$12.29. She was pastured for five months and was charged for this at the rate of \$1.00 per month, which is the ordinary charge for pasturing.

**Labor.**—The labor includes all time spent in milking and caring for the cow and in marketing the product. As the milk was shipped, it had to be delivered to the station every day, which required considerable time for both man and team, all of which must be accounted for.

**Miscellaneous Expenses.**—

The item for miscellaneous expense is the actual wear and tear on dairy equipment, cost of medicine, etc.

**Profit.**—The net profit appears very low; but in reality it is not bad at all, since every bit of work done and feed fed was paid for in full and a fair rate of interest has been paid on money invested in the cow and in the buildings.

There is an additional profit to the farm by keeping live stock, as most of the fertilizing value of feeds fed is retained on the farm in the form of manure. The manure produced by a cow in one year is worth several dollars to the average farm.



Fig. 70.—Weighing Feed.

The cow also had a calf which is worth something; and, had the butter-fat been sold to the creamery instead of shipping the whole milk, about 5,000 lbs. of skimmed milk would have been available for feed; which is worth, at 15c per hundred pounds, \$7.50.

We hope some of our readers will begin at once to weigh the milk produced and feed consumed by some or all of their cows. Also, keep a record of the amount of

time spent in caring for them. It is very interesting to foot up such accounts each month and to know whether one is making or losing by keeping stock.

### Questions:

1. What do you understand by the terms Inventory, Depreciation, and Profit?
2. How can you determine the number of hours of labor required to care for a cow a year?
3. What advantages are there in keeping cows besides the profit shown in an account similar to the one given above?

### Arithmetic:

1. If a cow gives 18 lbs. of milk per day, how much will she give in 300 days? How much butter-fat does she give each day if her milk tests 4% fat? How much butter-fat will she give in 300 days? How much is the butter-fat worth at 30c per pound?
2. If a cow is fed each day 4 lbs. of corn worth 56c per bu. (56 lbs.), 2 lbs. of bran worth \$25.00 per ton, 12 lbs. clover hay worth \$5.00 per ton, and 10 lbs. of fodder corn worth \$4.00 per ton, how much does it cost to keep her one day? To keep her 200 days?
3. How much does it cost to pasture a cow 165 days at \$1.00 per month?

### MARKETING DAIRY PRODUCTS.

**Item of Expense.**—Getting dairy products to market is an item often overlooked in considering the cost of production and the profits in dairying. This item is much larger than one would believe at first thought. It is, however, a necessary item of expense, but often a little consideration and planning will greatly reduce the cost and add a corresponding amount to the profits.

**Making Butter on the Farm.**—There are a few who cling to the old method of making butter on the farm, and there are probably places where this is necessary, but where it can be avoided and the cream or milk sold

at a reasonable price it is preferable to do so. In churning by hand, more of the butter-fat is lost than when cream is churned in a large churn at the creamery. Butter makers in creameries do nothing but make butter. They make a study of it; and, having better facilities than are usually found in the home, make a better quality of butter.

**Overrun.**—Milk usually contains from 3 per cent to 5 per cent butter-fat, and cream from 20 per cent to 40 per cent butter-fat. A pound of butter-fat will make more than a pound of butter, because butter contains

from 12 to 15 per cent water; also some salt and casein. This increase in weight is called by butter makers the **overrun**. A good butter maker with modern creamery equipment can get an overrun of from 18 to 24 per cent. If he buys 100 pounds of butter-fat he can make from 118 to 124 pounds of

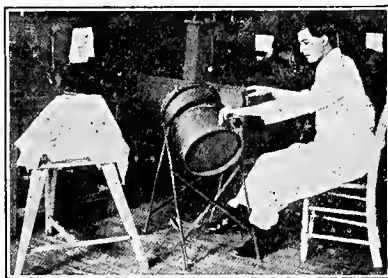


Fig. 71.—Home Manufacture of Butter.

butter from it. It is very seldom that one can get as large an overrun, when churning a small amount of butter on the farm, as can a good butter maker in a modern creamery. While one can get more pounds of butter by churning his cream himself than he had pounds of butter-fat in the cream, yet he cannot as a rule get as many pounds of butter as could a butter maker by churning the same cream in a modern creamery. This fact, together with the fact that home dairy butter is not quite so marketable as creamery butter, makes it the part of wisdom, on most farms, to sell the cream or milk at the local creamery; or, if no creamery is convenient, to ship either the milk or the cream, rather than to make butter on the farm.

**Exceptions.**—There are times when it may be wise to make butter on the farm, but at present such conditions are exceptional. In deciding which method to follow one should not overlook the fact that butter making on the farm usually falls to the housekeeper; who, as a rule, has too much to do without this unnecessary work.

**Selling Whole Milk, or Cream.**—The majority of farmers now separate their milk, keep the skimmed milk at home for their calves and pigs, and sell their cream. A few, however, who live within reasonable shipping distances from large cities, ship the whole milk to milk dealers who peddle it out in small quantities to the consumers. When farmers ship milk in this way they usually sell it by the hundred pounds, and there is often considerable of a problem involved to determine which is more profitable—to ship whole milk or to sell the cream. A specific problem will illustrate how any one must decide which is the better method to practice. A farmer living three miles from town, and the same distance from a creamery, has ten cows, each giving daily 20 pounds of milk testing 4 per cent butter-fat.

**Whole Milk.**—If this farmer ships whole milk to the city, he must deliver it every day, seven days each week. It will take a man and team two hours each day to get the milk to the station. The time of a man and team is worth about 30 cents per hour. Thus the cost of marketing will be 60 cents per day or \$4.20 per week.

**Cream.**—If he separates his milk and sells the cream he will need to deliver it but three times a week, which at 60 cents a trip will cost \$1.80. He will have to separate 100 pounds of milk and wash the separator fourteen times during the week. Allowing half an hour for this it amounts, in a week, to seven hours. Man labor is worth about 15 cents per hour, which will make the separating cost \$1.05. The cost for interest, depreciation and repair on the separator will be about 25 cents per week. Thus the separating and delivering will cost \$3.10 per week.

In addition to a saving in the cost of marketing, if the cream is sold in place of the whole milk, this farmer will have about 1175 pounds of skimmed milk, which at 15 cents per hundred is worth \$1.76.

**Questions:**

1. What item of expense is often overlooked in the cost of dairy products?
2. Give at least three reasons why it is usually not wise to make butter at home.
3. What do you understand by the creamery man's term "the overrun?"
4. Compare the items of expense in selling whole milk with selling cream.

**Arithmetic:**

1. If a butter maker gets an overrun of 20%, how much butter will he make from 986 lbs. of cream?
2. If a man has 10 cows, each giving 20 lbs. of milk per day, how many pounds of milk will he get per day? How many pounds of butter-fat will he get if there are 4 lbs. of fat in each 100 lbs. of milk?
3. What is the value of 1175 lbs. of skim milk at 15c per hundred pounds?

**CO-OPERATION IN MARKETING.**

**Co-operation Reduces Cost.**—In the preceding pages we found that the farmer who hauled his cream to the creamery three times each week spent 6 hours of time for himself and team; which, at 30 cents per hour, costs him \$1.80 per week or \$93.60 per year, simply for marketing the cream from ten cows, each giving daily 20 pounds of milk testing 4% fat. This is certainly quite an item, especially at a time when farm help is as scarce as it is at present.

If three such farmers would co-operate in hauling cream, so each would haul but one day each week, the cost would be but very little more than one third as much as when each markets his own cream. This would amount

to a saving each year of about \$60.00 per farm or \$6.00 per cow.

We have found (page 168) that it cost a farmer, with ten cows, \$4.20 per week or \$218.40 per year to market whole milk, because he was obliged to go to market every day. If three such farmers, living near each other, were to co-operate in marketing their milk, about 2-3 of this cost, or \$155.00, would be saved to each farm; which is over \$15 per cow per year. An increased profit of \$15.00 per cow is sufficient to make it worth consideration.

**Creamery Company Hauls Cream.**—It has been suggested that instead of each farmer hauling milk or cream to a creamery, the creamery company employ teams to haul the cream or milk from all the farms. It would



Fig. 72.—Marketing Milk at the Creamery.

certainly seem that there might be a very great saving realized were this suggestion followed. One man and team thus employed could haul all of the cream from 20 to 60 farms, depending on the conditions of roads, distance to haul and size of herds.

**Questions.**—We wish each of our readers might spend a few moments figuring on these problems as they might apply in his particular locality. If you can answer the following questions you can figure the problems easily.

How many times per week do you deliver milk or cream?

How much time, on the average, is required to make the delivery?

How many hours of time will a man spend in a year to deliver your milk or cream? What is the total cost of this labor at 15 cents per hour?



How many hours of horse labor will be required in a year to deliver your milk or cream? What is the total cost of this labor at 8 cents per hour per horse?

The above figures will enable you to find the total cost of marketing the product of your dairy when you do it by yourself. It will be worth while now to figure, in the same manner, what it would cost you were you to exchange with two or three of your neighbors, so you will have to go but every third or fourth time.

Still another valuable problem will be to find out how many farms could be reached by one team circling around so as to reach the greatest possible number of farms and get back to the creamery by traveling from 10 to 14 miles.

To make such a trip one half day's time for man and team would be required, at a cost of \$1.50 to \$2.00. Figure whether or not this would be a saving over the common practice of each delivering his own cream.

### Questions:

1. In what manner are the dairy products of your farm marketed?

2. Are there two or more of your neighbors living near your place, so you might co-operate with them in hauling your milk or cream to the creamery or to the station?

3. Would it not be practical for the creamery company to employ one or more teams to collect milk or cream, instead of each farmer trying to deliver it himself?

### Arithmetic:

1. If 100 pounds of milk were run through a separator and 4 pounds of butter-fat taken out, and with the butter-fat 12 pounds of milk, how many pounds of skimmed milk would be left? (Note. 4 pounds of butter-fat in 12 pounds of milk would make 16 pounds of cream testing 25 per cent fat, which is about the average for cream.)

2. If the four pounds of butter-fat taken from the 100 pounds of milk were sold for 33 cents per pound,

and the skimmed milk were worth 15 cents per hundred, what would be the income from the 100 pounds of milk?

3. Assuming that it costs 10 cents per 100 pounds more to market whole milk than to separate and market cream, at what price per hundred pounds must 4% milk be sold to be as profitable as to sell the cream at 33 cents per pound for butter-fat?

### FENCING.

**Kinds of Fences.**—Fences of some description are found on nearly every farm. Sometimes these fences are in such poor condition that they are very little improvement to a farm, while on other farms they are straight, well built, well kept and a very great addition to the farm both in usefulness and in appearance.

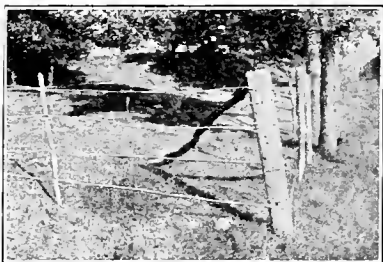


Fig. 73.—A poorly braced corner post from which it is impossible to stretch wires and have them remain tight.

Fences are used to keep stock either in or out of fields, and different kinds of stock require different kinds of fences. Formerly fences were made of rails, but late years timber is more scarce and other fencing material is being used. Barbed wire and woven wire are now comparatively cheap, easily put up, and so effective in enclosing stock that practically all fencing is of this material, even in timbered sections where rails are plentiful.

**Fence Posts.**—There are a great number of fence posts used every year, and, as timber becomes scarce, posts become more and more expensive. There are many different kinds of timber used for fence posts, and they vary in value according to their durability. Some kinds of posts will last from ten to twenty years before they rot, while other kinds will become useless in three or

four years. As a rule, posts that last well are made of slow-growing timber, such as oak or cedar, while quick-growing timber, such as willow and cottonwood, rots very quickly when placed in the soil.

Posts deteriorate when set in the ground, by rotting. They usually rot off just below the surface of the ground, because here the soil keeps them moist and the air gets in from the surface, thus making conditions favorable for rotting. The top of the post does not rot, as it dries off too quickly, and the bottom of the post does not rot, because the soil keeps the air away from it.



Fig. 74.—A well braced corner post that will always remain perpendicular and hold the wire tight.

**Cement Posts.**—Cement is now used for making posts, by mixing it with sand and water, then tamping it into moulds of the proper shape. Such posts are very serviceable and get better the longer they stand. The only way in which they are injured is by breaking them. To prevent this, strips of wire are usually put inside of the posts as the mortar is being put into the moulds. Cement posts are not in general use, as few people have learned to make them. The first cost of cement posts is higher than for wooden posts. They are heavy to handle and some little difficulty is found in fastening

the wire to them. But considering their durability they are not expensive and will probably be used to a great extent as people learn more about them.

A process has been discovered by which wooden posts may be treated with creosote and thus made to last two or three times as long as when untreated. This process is to dip the posts (or the part that is to go into the ground) in a vat of hot creosote. The creosote soaks into the wood and keeps them from rotting.

**Investment in Fences.**—Fencing is done entirely for live stock, hence the cost should be charged against them. Fencing intelligently done offers a good investment, but sometimes fences are built when they should not be. Unless there is sufficient live stock on the farm to make good use of fences, and unless the live stock are of such quality as to yield a profit from good feed, fences are not a profitable investment.

The larger the fields fenced, the smaller the amount of fencing required per acre, hence it costs less for fencing if one has enough cattle to use a large pasture than when one has only a few head that can use only a small amount of pasture. Figure this out for yourself.

Investing money in fences is different from investing it in land, because fences deteriorate each year and after ten or twelve years must be replaced. If one invests \$10 in land, it is probable the land will always be worth \$10 or more, and the only cost each year is the interest on the investment. If one invests \$10 in fences, the cost of the fence each year is interest on the investment and whatever depreciation there may be. If the fence lasts 10 years, it is worth \$1 less each year. Thus the fence must earn about \$1.60 per year to pay its cost, while the land must earn but 60c per year.

### Questions:

1. What is the chief use of fences?
2. Of what are they usually made now?
3. Upon what does the value of fence posts depend?
4. By what process are wooden posts made more durable?

5. Why must an investment in fences be considered differently from an investment in land?

**Arithmetic:**

1. How many acres of land in a field 40 rods wide x 120 rods long? How many rods of fencing are required to enclose it? How many rods of fencing are required per acre?

2. How many acres of land in a field 80 rods square? How many rods of fencing are required to enclose it? How many rods of fencing are required per acre?

3. If fencing costs 25 cts. per rod and lasts ten years, what is the annual cost per rod? (Figure 6% interest on 25 cts. and add to it 1-10 of the cost of the fence.) How much is the annual cost per acre of such a fence if 10 2-3 rods are required to enclose an acre?

**BUILDING FENCES.**

**Good Workmanship.**—In building fences, like most other kinds of work, a man can show whether or not he is a good workman. If one sees straight, well built and well kept fences on a farm, he expects, and is very likely to find, other things on that farm orderly and properly done. A fence often remains in place for many years. If it is crooked, it is an eyesore all those years. If it is straight and well kept, it is a constant source of satisfaction to the owner and to all who see it.

**Corner Posts.**—Barbed wire fences have been the cause of so much injury to animals that many people are strongly opposed to them. The greatest cause of injury to live stock is slack wires. These are not found where the wires have been properly stretched when the fence was built. In order to stretch wire tight it is necessary to have the corner posts set and braced firmly, so they cannot give and thus allow the wire to slacken. With corner posts set as in Fig. 73, it is impossible to keep the wire tight. But when they are set and braced as in Fig. 74, they will always remain firm and keep

the wire tight. (Observe the fences in your neighborhood and make note of those that have well braced corners.)

**Setting Posts.**—Posts are usually set by digging holes with a post auger or digger, setting in the posts and tamping the dirt firmly about them. It is especially important to tamp the dirt very firm about the bottom of the post and just at the surface of the ground, as these are the two places on which the strain comes. Corner posts often need short pieces of plank spiked on them near the bottom, to keep the strain of the wire from pulling them out of the ground. See Fig. 75.

**Woven Wire.**—Woven wire makes a much more desirable fence than barbed wire, as there is no danger of animals being injured in it and it will serve for hogs and sheep as well as for cattle and horses. It is considerably more expensive than barbed wire, especially if only cattle are to be enclosed.

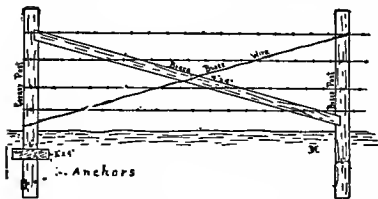


Fig. 75.—A corner post braced one way and anchored so the strain of the wires will not pull it out of the ground.

**Stretching Wire.**—If corner posts are firmly set, it is comparatively

easy to stretch either barbed or woven wire. The wire is fastened firmly to the post at one end of the line, then strung out and stretched. A great deal of time can be saved by arranging to reel out two wires at once. To do this, put two spools of wire side by side on a rod or crowbar in rear end of the wagon, fasten the two wires and drive ahead, the same as when stretching one wire. Always stretch the top wire first, as you thus avoid tangling when the other wires are stretched.

There are several good wire stretchers on the market. If one has no other means handy, barbed wire can be well stretched by bracing a wagon, blocking up one hind wheel and winding the wire about the hub by turning the

wheel by hand. A stretcher especially made for the purpose is necessary for stretching woven wire.

**Cost of Fencing.**—Any farmer should be able to tell approximately how much it costs to build any of the common fences on his farm. It is the annual cost per acre that is important. To find this, one must first take into consideration the number of rods of fencing required to enclose an acre. This, of course, varies with the size and shape of the fields. The cost of posts and wire is known, because they are usually purchased. If posts are cut on the farm, the cost of getting them out will represent their cost. Labor cost in setting posts and stretching wire can be found by experience or by asking others who have built fences under similar conditions. When one knows the total cost per rod for a certain fence, and the number of rods required to enclose an acre, he can tell the total cost per acre.

### Questions:

1. For what reasons should corner posts be well braced?
2. Describe an easy method of stretching wire.
3. In what way may one determine the cost per rod of fencing?
4. If one knows the cost per rod, how can he tell the annual cost per rod? Per acre?

### Arithmetic:

1. How many posts are required to build 80 rods of fence, posts  $1\frac{1}{2}$  rods apart? What are they worth at 12c per post? What is the cost per rod for posts?
2. How many pounds of barbed wire are required to build 80 rods of 3 wire fence? (A single barbed wire 1 rod long weighs about 1 pound.) What is the cost at 3c per pound? What is the cost of such a fence per rod for wire?
3. A man can set 50 posts in 10 hours. How long will it take him to set the posts in 80 rods of fence, if

posts are  $1\frac{1}{2}$  rods apart? What will it cost if his time is worth 14c per hour? What is the cost per rod?

4. Two men and a team (2 horses) can string, stretch and staple 80 rods of fence (3 barbed wires) in 5 hours. What will it cost if a man's time is worth 14c per hour and a horse's time is worth 8c per hour? What will it cost per rod?

5. What, then, is the total cost per rod to build a fence as above? (Include posts, setting of posts, wire and stretching of wire, as found in above examples.)



## CHAPTER IX.

### LIVE STOCK.

#### CARE OF LIVE STOCK.

**Chores.**—Farm boys are, as a rule, occupied a considerable portion of the time, mornings and evenings, caring for the stock. As the profits derived from the live stock depend to a great extent on the care they receive, it is certainly worth while to spend a little time considering how the "chores" may be done more quickly, more easily and better.

The amount of live stock kept on the average farm is bound to increase as more intensive systems of farm-

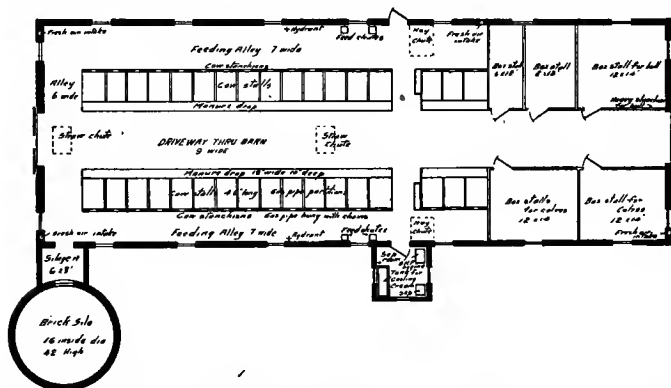


Fig. 76.—A well arranged barn in which the "chores" may be done in a minimum amount of time.

ing become necessary. This makes the proper care and management of live stock a matter of increasing importance.

**Be Systematic.**—System in doing the chores is fully as effective as system in studying. A carefully thought out plan that will enable one to get a certain amount of work done with the fewest steps and least possible

delay, will very often change a tedious and unpleasant chore time of an hour into a half hour pleasant pastime. To lead four or six horses out to water, and then clean the stable with the horses in their stall, requires much more time than is necessary if the yards and the watering trough are so arranged that the horses can be turned out to get a drink by themselves, and the stable cleaned while they are out. If horses are turned out to drink before they are fed their grain, as they should be, they will, as a rule, return to the barn promptly. If you are not caring for your horses in this manner, try it and notice the saving of time. Or if you are doing it, take account of the time it takes you to care for your horses, and compare notes with some one of your neighbors who is still leading his horses out to water.

**Value of Time.**—Many men who work in factories and at other occupations are paid by the hour on the basis of the amount of work they can do, and every minute of their time must be made to count. Such rules are not possible on a farm, but a young man who expects to farm can and should make himself just as proficient as possible. Not with the idea of learning to do twice as much in a day as an ordinary man can do, but to so direct his efforts and utilize his time as to be able to do a good day's work as easily and in as short a time as is consistent with good work.

Some men have a system of harnessing and hitching a team, and can do it better and in much less time than can the man who has no system and consequently does it in a different way each time.

**Milking ten or twelve cows twice each day** is a comparatively easy task for a man who can milk them in an hour, while to milk the same cows would be almost drudgery to the man who can milk but five or six in an hour. Men can make themselves very proficient, and learn to do things rapidly and well, by application and practice. This is shown in corn husking. Twenty-five bushels of corn is a fair day's husking for a beginner, but many men by practice get so they can husk

from sixty to over one hundred bushels in a day. Time is much better spent in wholesome recreation than in dallying.

**Make Animals Comfortable.**—One of the first essentials in caring for animals is to make them comfortable. Hogs cannot fatten, hens cannot lay, cows cannot give a good flow of milk and horses cannot continue to do a good full day's work, unless they are made comfortable. Every time an animal is made uncomfortable, either by being left hungry, thirsty or cold, by lying on a hard bed or by being dogged or pounded, the owner loses money by getting less returns from the animal.

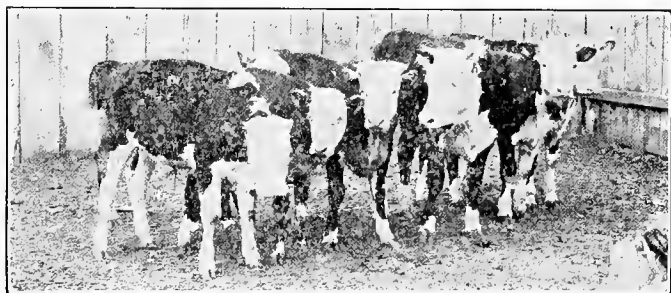


Fig. 77.—Hereford calves out for exercise in a protected yard. Stock should be left out in winter only so long as they will be comfortable.

**Exercise.**—All animals need some exercise, but milch cows should not be left outside to shiver in the cold. One practical dairyman says, "Leave the cows out no longer than you care to stand out in the same place with no overcoat on and nothing to do." If one follows this rule, cows will be left out but a short time in the cold or wet weather. Keep the cows in the barn most of the time during the winter, and give them a good bed and plenty to eat and drink.

**Warm Water for Cows.**—Our best dairymen find that it pays to take the chill off of water for the cows. A very little fuel in a tank heater will take off the chill of the

water. If it is not warmed in this way the expensive feed that the cow eats will be used to warm the water. Besides, on a cold day a cow will not drink as much ice-cold water as her system requires.

**Questions:**

1. Why should we plan to "save time?"
2. What is the most important thing in caring for animals?
3. How long should cows be left out on cold days?
4. Give two reasons for warming water for cows.

**Arithmetic:**

1. A man by having a handy barn may save 20 minutes per day in doing chores. How many hours may he save in a year? How much is this time worth at 14c per hour?

2. A cow drinks 90 lbs. of water per day. It takes the energy generated by  $1\frac{1}{4}$  lbs. of oats to warm 90 lbs. of water from 32 degrees to the temperature of the cow's body. How much does it cost to warm this water if oats are worth 35c per bu.?

It takes the available energy generated by burning  $1\frac{1}{2}$  lbs. of dry oak wood to raise the temperature of 90 lbs. of water from 32° F to 103° F. How much does it cost if a cord of dry oak wood, weighing 3,800 lbs., costs \$5.00 per cord?

**SHELTER FOR LIVE STOCK.**

**Kind of Shelter.**—To make live stock comfortable in the northern part of the United States and in Canada, good shelter must be provided. Expensive shelter is not necessary, but the object sought should be a barn that will keep the animals warm, be healthful, and so arranged that stock can be easily and quickly cared for. Usually the buildings at hand, if not already satisfactory, can be made very serviceable by a little effort and planning.

**Buildings Should Be Warm.**—Buildings should be so constructed as to keep the animals warm. If the animals are not kept warm by shelter some of the food they eat will be used to warm them, and it is cheaper to provide good shelter. Besides, if animals are not comfortable,

they cannot do well. This is especially true of milch cows and young stock. Fattening steers and sheep do not require very warm quarters so long as they are protected from the storms and the wind.

**Light.**—Plenty of windows should be provided, so the sunlight can reach just as much of the interior of the building as possible. Sunlight is a deadly enemy of bacteria and disease germs. There is no better disinfectant than sunlight, and it is so cheap that every building should be amply supplied. Tuberculosis is very common among domestic animals, and it is generally believed that it may be transmitted from animals to man, especially in milk. So it is not alone for the comfort of the animals and the profit we derive, that we provide healthful quarters, but to guard the health of the family as well.

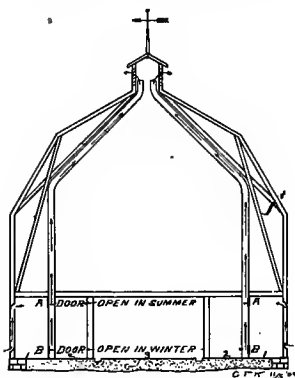


Fig. 78.—A good system of ventilation for a barn. Fresh air comes in near the ceiling. Foul air is taken out from near the floor. After King.

**Ventilation.**—By good ventilation we mean such a system as will remove the foul air from the stable. Leaving a door or a window open is not good ventilation, as it causes a draught and lets out the warm air. A better way is to have one or more flues built in the barn, that will carry the foul air out. Warm air is lighter than cold air, hence it rises. A stable is warmer near the ceiling, if the ceiling is tight, than near the floor. Hence the ventilator flue should open near the floor so as not to take out the warm air. The carbon dioxide exhaled by animals is heavier than air, hence it

settles to the floor and will be taken out by such a ventilator. Air should be let into the stable near the ceiling, whence it will gradually settle and become partially warmed before it reaches the animals. The illustration Fig. 78, shows how a ventilator should work. Notice the

barns in the neighborhood and make a note of the number of windows and ventilators. How is your barn lighted and ventilated?

**Conveniences.**—Since chores must be done so many times each year, just a few minutes lost each time they are done amounts to many hours in a year, probably several days; hence it is well to plan to have the barns handy. Feed, both hay and grain, should be stored where it can be easily gotten to the feeding alleys, and the alleys should be sufficiently large so one can work in them conveniently. Cleaning the stables is probably the heaviest part of the chores, and should be made as easy as possible. If the stalls are so arranged that a team can be driven through the barn and the manure loaded in a spreader, wagon or sled, and hauled directly to the field, it will be much easier than where it is necessary to throw it to one end or side of the barn, then throw it out of a door or a window and pitch it into a wagon outside. This last method is common on many farms, and results in a great loss of labor and time, besides a loss in the value of the manure. The sooner manure can be put onto the field after it is taken from the stable the better. A manure pile laying under the eaves of a barn for a few months may lose one-half of its value. If a new barn is being built, or the old one changed, a great deal of thought and study should be put on it to make it as convenient as possible. A day spent in planning the alleys, stalls, etc., for convenience, may save many day's work each year.

**Cost.**—A feature that must not be overlooked is the cost of a barn. A barn is built to shelter stock, and stock is kept for profit. When a barn is built, it must earn for the farmer enough each year to pay interest on the investment, cost of insurance, taxes, repairs and yearly depreciation. (If a barn costs \$1,000 and lasts 25 years, the yearly depreciation is \$40.) Good barns are desirable; but sometimes barns are built on farms where live stock is so poorly managed that it fails to bring in even the yearly cost of the building; and in such cases

the investment results in a loss. Care should be taken that the yearly cost of shelter is not so high as to take all profit from the animals kept. By carefully figuring out the problems given above, one will get an idea of how to study such problems.

**Questions:**

1. Why should buildings be warm? Why light? Why well ventilated?
2. Why should buildings be made convenient?
3. Is there any danger of investing too much money in farm buildings?

**Arithmetic:**

1. (a) A barn costs \$1,000 and will last 25 years. What is the average yearly depreciation in the value of the barn? (1-25 of \$1,000.)

(b) How much is the interest charge per year on \$1,000 at 4 per cent?

(c) How much is the yearly cost of insurance on the barn at 50c per \$100?

(d) Such a barn will cost about \$10 per year for repairs. What is the total yearly cost of the barn?

(Note: It is the sum of the yearly depreciation, interest, insurance and repair charges.)

2. If such a barn will shelter 20 head of stock, what will be the yearly cost per head for shelter?

3. In a similar manner figure the yearly cost per head for shelter in a \$4,000 barn that will shelter 40 head of stock. (Note: Find depreciation, interest, insurance and repairs at same rate as in example No. 1.)

**TESTING MILK.**

**Babcock Test.**—How many of our readers know of Dr. S. M. Babcock, and that he invented the Babcock test? The Babcock Test is one of the great inventions of the age, and has done a great deal for the dairy industry. Before this invention there was no way to tell the different grades of milk. It was known that some cows gave richer milk than others, but the only way to tell the

amount of butter-fat in a given sample was to raise the cream and make it into butter. When all the butter was made on the home farms, it was not so necessary to know the quality of milk; but when creameries became common, and milk was hauled from different farms to a creamery, it became very important to know how much



Fig. 79.—A High Type Dairy Cow. Her value is best told by her record in the herd, which can be told only by weighing and testing her milk.

butter-fat each sample contained, so it could be paid for in proportion to its value.

Dr. Babcock realized this need, and, after years of effort, invented a test by which any sample of milk may be tested in a very short time and its per cent of butter-fat determined. This makes it possible for every farmer, who hauls milk to a creamery, to get paid for it in exact proportion to the amount of butter-fat it contains.

**Principle of the Test.**—This test is very simple, and makes use of a few facts that everyone knew before the test was invented. It was known that, if milk were set away for several hours, cream or butter-fat would rise to the top. This indicated that cream is lighter than the



rest of the milk. Every boy, who has ever turned a grindstone, knows that if water is poured on a grindstone, and the stone turned rapidly, the water is thrown off. This indicates that anything revolving has a tendency to be forced away from the point around which it is revolving.

Dr. Babcock made use of these two principles by devising a machine in which bottles can be set and revolved rapidly. To make the test, a certain amount of milk is put in a test bottle and some sulphuric acid added. The acid assists in breaking down the milk, and makes it easier for the fat to be separated from it. The test bottles are of a certain size and shape. They are put in the machine, which is then turned at a given speed. The cups in which the bottles are set swing outward, as the speed increases, until the bottles are in a horizontal position, with the bottoms the farthest away from the center, around which they are revolving. This rapid revolving tends to force all the milk into the bottom of the bottle, just as turning the grindstone tends to throw water away from it. Milk, being heavier than cream, is crowded with more force into the bottom of the bottles. This crowds the fat into the necks of the bottles. The acid added to the milk causes it to turn dark, and the butter-fat is amber colored, so the fat is easily told from the milk. The necks of the bottles have scales on them, or marks just so far apart, and as the cream is forced into the neck, one notices how many spaces on the necks of the bottles are filled with fat, and the number of spaces filled indicates the per cent of the fat in the milk. If three spaces are filled, the milk tests three per cent, and if four and a half spaces are filled, the milk tests four and a half per cent.

**Milk Test.**—If we say milk tests five per cent fat, we mean that in one hundred pounds of milk there are five pounds of butter-fat. One hundred pounds of six per cent milk is worth twice as much at the creamery as one hundred pounds of three per cent milk.

At every creamery this test is used, and when a farmer

brings milk to the creamery, the butter maker weighs it, takes a sample and tests it. The total weight multiplied, by the test of the milk and divided by one hundred, gives the pounds of fat and affords the basis on which the milk is paid for. Thus if a farmer delivers one hundred seventy-five pounds of milk and it tests four per cent, the problem is solved as follows:  $175 \text{ lbs.} \times 4 = 700 \text{ lbs.} \div 100 = 7$ , number of pounds of fat.

Cream is not pure butter-fat, so must be tested also.

### Questions:

1. Why was some device for testing milk badly needed?
2. Who invented such a device?
3. Upon what principles does it work?
4. If you have seen testing done at the creamery, describe it as best you can.
5. What is meant by per cent of fat in milk?

### Arithmetic:

1. A hauls 230 lbs. of milk to the creamery. It tests 3.5% fat. How many pounds of butter-fat does it contain? How much is the butter-fat worth at 34c. per lb.?
2. B hauls 150 lbs. of milk to the creamery. It tests 4.5% fat. How many pounds of fat does it contain? How much is the fat worth at 34c. per lb.?
3. C delivers 75 lbs. of cream to the creamery. It tests 24% fat. How many pounds fat has he? How much is it worth at 34c. per lb.?

### TESTING COWS.

**Culling.**—Now that dairying is getting to be such an important part of farming, farmers are studying how they may secure greater profits. They have found that if they are to realize satisfactory returns on dairying, they must keep only cows that are capable of producing large amounts of milk and butter-fat. They have found also that the only way to know just what each cow is doing is to weigh the milk. At first this seemed like an unnecessary amount of work, but now nearly every good dairy-

man tests his cows and finds that it pays him, because it takes less time to test the cows than to milk one or two unprofitable cows.

Good care, is absolutely essential to successful dairying, but even with good care some cows will not give profitable returns.

**Weighing Milk.**—In order to know just what each cow is producing, it is necessary to weigh the milk. This is very simple if one has a spring balance hung in the barn

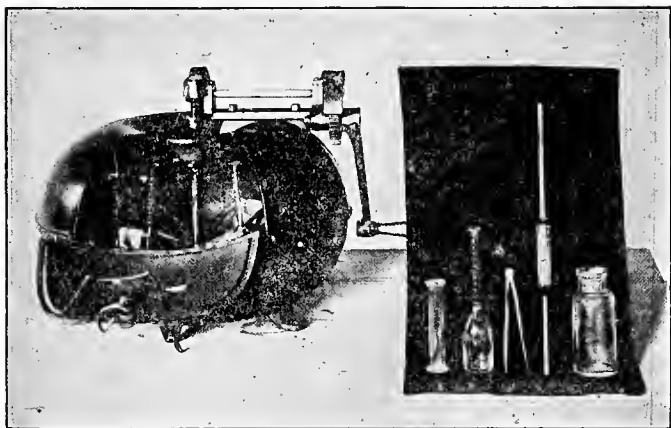


Fig. 80.—Outfit for making the Babcock test. From left to right, an eight bottle tester; a graduate for measuring acid; a test bottle; compasses for measuring fat in neck of bottle; a pipette for measuring milk, and a sample bottle.

near the milk-can, and a sheet of paper with a column for each cow, tacked up nearby, so the results can be jotted down as the milk is weighed. It is not necessary to weigh the milk every day. Weighing it night and morning, once every ten days, or even once a month, makes it possible to determine quite accurately the amount of milk a cow has given for the month.

**Advantages of Weighing Milk Every Day.**—There are a great many advantages, though, in weighing milk every

day. By so doing one knows accurately how much milk a cow has given during the month. It also enables one to tell at once if a cow gives less than her usual flow of milk. If a cow has been giving fifteen pounds of milk.

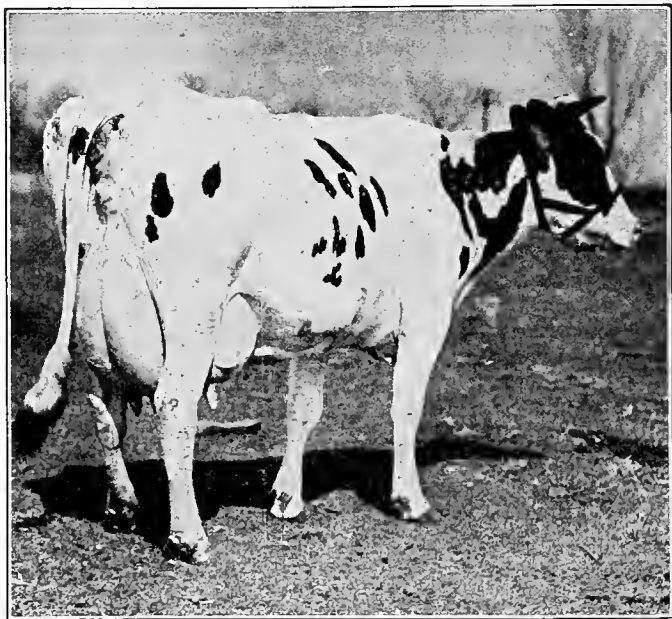


Fig. 81.—A pure-bred holstein cow. She gave in 30 days, 114.9 pounds of butter.

and suddenly drops to thirteen pounds, one's attention is called to the fact just as soon as he weighs the milk. He is, of course, interested at once, and looks for the cause. He may find that the cow got out of the yard and the dog was set on her. He may know that she was left out in the cold longer than she should have been, or that she was turned out to get a drink when the wind was so cold, and the water so near frozen, that she did not get the amount

of water she needed. He may find that a window or door was left open and the cold draught chilled her. Whatever the cause of the loss in milk may be, if one's attention is called to it he can usually find out and remedy it.

**Sampling.**—A sample to be tested for the per cent of fat should be taken just as the milk is being weighed. Stir the milk in the pail, to make sure it is all uniform, then take a small sample in a bottle. Each sample may be tested soon after being taken; or a simpler way is to take several samples from the same cow and keep them in one bottle, and test all together. In this way of testing, some preservative must be added to keep the samples from spoiling.

**Testing.**—Any careful boy, twelve or more years old, can test milk if he has a tester and is shown how. Or if the milk is weighed at home and samples taken, the creamery man will, as a rule, test them for a very small charge or for nothing. At one place the farmers pay three cents a sample for testing. If one has a sample tested each month from a cow, it would cost but thirty-six cents per year, and this would certainly be a paying investment. In some places the farmers form a cow-testing association and hire a man to test all the cows. He comes to each farm once a month, and weighs and tests the milk from each cow night and morning, then goes to the next farmer. This is a very satisfactory arrangement.

**Work for Boys.**—Any boy who is milking cows can get some good lessons in arithmetic, and greatly increase his knowledge of dairying, by trying the work suggested herein. He can weigh the milk separately from each cow, take one or more samples from each cow's milk each month, and test them at home or have the creamery man test them. In this way he will know how much milk each cow gives during the month, and the per cent of butter-fat it tests. He can then (probably at school) figure out how much butter-fat each cow has given during the month. It will be interesting and valuable to compare the records from the different cows; and probably the boys

would be interested to compare the records on the different farms, and in trying to find out why the cows are doing better on one farm than on another.

**Questions:**

1. For what reason is it wise to weigh and test the milk from each cow on the farm?
2. What are the advantages in weighing the milk from each cow at each milking?
3. Tell how you would take a sample of milk for testing?

**Arithmetic:**

1. A cow gives an average of 20 pounds of milk per day for 300 days each year. What is her yearly milk production?

2. A cow gives 6,000 pounds of milk in a year, testing 4 per cent fat. How many pounds of butter-fat does she give? How much is the butter-fat worth at 30c. per pound?

3. A cow gives 6,000 pounds of milk in a year, testing 5 per cent fat. How many pounds of butter-fat does she give? How much is the butter-fat worth at 30c. per pound?

4. The average cow in the state gives about 4,000 pounds of milk in a year, testing about 4 per cent fat. How many pounds of butter does she give? What is it worth at 30c. per pound?

**POSSIBILITIES OF THE DAIRY COW.**

**What are Your Cows Doing?**—How many of our readers know how much milk each of their cows gives in a year and the actual cost of keeping each cow for the same length of time? Does it not seem strange that so few people take the trouble to know these things, when they have such important bearing on the profits of the farm? We want to interest our readers in this and get them to find out what their herds are doing. It will be much more interesting to feed and milk the cows if one gets interested in seeing how much he can make them

produce. If one makes up his mind that a certain cow can give 6,000 lbs. of milk in a year, or an average of 20 lbs. daily for 300 days in a year, he will want to weigh the milk every day to see if he is getting the 20 lbs. If she gives a little less one day than she did the day before one will try to find out the cause and remedy it. If one but makes up his mind that certain results can be secured, he will be anxious to feed properly and may wonder what is the best kind of feed to make a cow give milk. He will want to read how other people whose cows give large amounts of milk, feed their herds.

**Increased yields.**—If every farmer were to become interested in his cows and feed and care for them just the best he could, the average record of dairy cows would be increased to the extent of fifty or one hundred pounds of butter-fat per cow per year. If butter is worth 30c. per pound, such an increase would mean an increased income from each cow of \$15.00 to \$30.00 per year.

Many farmers, who have become interested in caring for their cows, have increased their production of milk and butter until their whole herds give an average yield of from 250 lbs. to 350 lbs. of butter per year.

**A Good Cow.**—What would you think of a cow that would give 1000 lbs. of butter in a year? There is such a cow in Wisconsin. Her name is Yeksa Sunbeam. This cow was at one time owned by a farmer in Minnesota, but the farmer did not know what a valuable cow she was, because he never weighed or tested the milk she gave, nor paid any particular attention to the way she was fed or cared for. So he sold her to a man in Wisconsin by the name of Rietbrock. Mr. Rietbrock liked cows, took good care of them and felt pride in seeing them look well and comfortable and in having them make large records.

By keeping records of his cows so he could discard the poor ones, and by careful feeding and breeding, Mr. Rietbrock has built up a herd of cows that is truly remarkable for its average production.

Twenty-five cows in this herd averaged, in one year, 10,663 lbs. of milk and 550 lbs. of butter fat per cow, and the one cow, Yeksa Sunbeam, made the phenomenal record of 1,000 lbs. of butter-fat in one year.

**Possibilities in Dairying.**—Mr. Rietbrock is an exceptional man and has an exceptionally good herd of cows, but any industrious boy who will study the matter of feeding, breeding and caring for cows, and who will go at it with a will, can, in a few years, grade up a herd of cows that will average at least 100 lbs. of butter more than the present average or from 250 to 350 lbs. per year per cow. Two such cows will bring in a large enough income in a year to pay the entire expense of one year at an Agricultural School.

We would like to see two boys in the same family, or in the same neighborhood, enter into a little contest to see which one could make his favorite cow or cows produce the greatest number of pounds of butter-fat in a year. To succeed in such a contest a boy would have to work and study and get advice from his parents. Such a year's earnest work would bring a good cash return, and would furnish an experience worth a great deal of money to any boy who expects to be a farmer.

### Questions:

1. How can you find out how much milk your best cow gives?
2. Is the average production of milk per cow as much as it should be?
3. What could farmers do to increase the average amount of milk given per cow?
4. What could you do to make the cows on your farm more profitable?

### Arithmetic:

1. The average cow gives about 150 lbs. of butter-fat in a year. How much is this butter-fat worth at 25c. per pound?



2. The average production of Mr. Rietbrock's herd was 550 lbs. of butter-fat in a year. How much is this butter-fat worth at 25c. per pound?

3. If it costs half of the value of the butter-fat for feed, how much does one get for his labor in caring for a cow that gives 150 lbs. of butter-fat? How much does he get for his labor if a cow gives 550 lbs. of butter-fat? (Butter-fat at 25c. per pound.)

#### FEEDING ANIMALS.

**Food Requirements.**—We have learned that the carbon dioxide exhaled by animals is used by growing plants; that this carbon dioxide in the air unites with water and other elements taken by the roots of the plants from the soil, and forms starch and other compounds of which plants are composed. The heat or energy given off by the sun is used to build up these compounds in the plant.

Animals are dependent upon plants for all of their feed. When plants, such as grass, hay or grain, are eaten by animals and digested, the compounds they contain are broken down and used by the animal body, and the energy required to build up the compounds in the plants furnishes energy to the animal.

Very few plants contain, in the right proportion, the elements required by animals, so a combination of two or more kinds of feed is found necessary to supply the animal with needed feed. Different kinds of animals, and animals doing different classes and amounts of work, require different kinds and amounts of feed. So the intelligent feeding of animals requires a knowledge of the composition of different feeds and of the requirements of the various classes of animals doing different kinds and amounts of work.

**Balanced Ration.**—When one feeds just the right kinds and amounts of feed to supply the needs of the animal fed, he is feeding a balanced ration. Such a ration is most satisfactory and economical because it sup-

plies all the elements needed, with no surplus of any one. All animals require feed that contains in the proper proportion the three compounds: Protein, carbohydrates and fat. (You have, in your Physiology, learned something of the character of these three elements.)

By careful experiments the amounts of protein, carbohydrates and fat required by different animals, doing various amounts of work, have been determined. Likewise the composition of the different feeds has been found by analysis and by feeding. It is, therefore, comparatively easy to so combine the common feeds as to very accurately supply the needs of any animal.

**Protein** is a term applied to a group of compounds containing nitrogen. Protein is used by animals to make muscle or lean flesh, bone, hair or wool, tendons, nerves, casein and albumen in milk, etc. No other compound can take the place of protein, consequently it is very important that enough of this compound be fed, or the animal cannot keep up in flesh and production or work. If too much protein is fed, it can replace the other elements; but, as feeds containing a high percentage of protein are usually expensive, it is not wise to feed more than is needed.

Feeds containing a large proportion of protein, as bran, oil meal, clover, etc., are called nitrogenous feeds.

**Carbohydrates** are those substances in feed that are composed of carbon, hydrogen and oxygen, but have no nitrogen. Sugar, starch, fibre, etc., are carbohydrates. They are used in the body to produce fat, or are burned in the body to produce heat or energy. They cannot be used in place of protein.

**Fat.**—The oils, wax and fats contained in feeds are called fat. It is used in the animal body for the same purpose as are carbohydrates. One pound of fat is worth as much as 2.2 pounds of carbohydrates.

Feeds containing a large proportion of carbohydrates and fat, as timothy or wild hay, corn, barley, etc., are called non-nitrogenous feeds.

**Questions:**

1. What is a "balanced ration?"
2. What is protein, and for what is it used in the animal body?
3. What are carbohydrates, and for what are they used in the animal body?
4. What substances are known as fat, and for what are they used in the animal body?
5. What classes of feeds are called nitrogenous feeds? What classes are non-nitrogenous?

**Arithmetic:**

1. Bran, oilmeal, and clover are feeds rich in protein. How much is each worth per pound when oilmeal is worth \$35.00 per ton, bran \$24.00 per ton, and clover hay \$5.00 per ton?
2. Corn, barley and timothy hay are feeds rich in carbohydrates. How much is each worth per pound when corn is worth 35c per bu. (56 lbs.), barley 39c per bu. (48 lbs), and timothy hay \$5.00 per ton?
3. There is 6.8% of protein in clover hay. How many pounds of protein in one ton? How much does the protein cost per pound if clover hay is worth \$5.00 per ton?
4. There is 12.9% of protein in bran. How many pounds of protein in one ton? How much does the protein cost per pound if bran is worth \$24.00 per ton?

**COMPOSITION OF FEEDS.**

**Classes of Feeds.**—Since the common feeds are divided into two great classes, nitrogenous and non-nitrogenous, it is well to know in which class each farm feed belongs. All of the common feeds contain protein, carbohydrates and fat, hence might be classed in either of these groups. The feeds containing a proportionately large amount of protein are classed in the **nitrogenous** group, and those containing proportionately large amounts of carbohydrates and fat are classed in the **non-nitrogenous** group. The common feeds used on the farm are also classed as grains or concentrates, and roughage. The following table shows the composition or digestible nutrients in common farm feeds:

**Digestible Nutrients in One Pound of Feed.****(1) Nitrogenous Grain Feeds.**

	Protein.	Carbohy- drates.	Fat.
Oats .....	.092	.47	.042
Shorts .....	.122	.50	.038
Bran .....	.129	.40	.034
Oil Meal .....	.293	.33	.070

**(2) Non-Nitrogenous Grain Feeds.**

	Protein.	Carbohy- drates.	Fat.
Corn .....	.079	.67	.043
Barley .....	.087	.66	.016
Emmer (Speltz) .....	.091	.68	.021
Rye .....	.099	.68	.011

**(3) Nitrogenous Roughage.**

	Protein.	Carbohy- drates.	Fat.
Alfalfa .....	.110	.40	.012
Red Clover .....	.068	.36	.017
Mangels .....	.011	.05	.001

**(4) Non-Nitrogenous Roughage.**

	Protein.	Carbohy- drates.	Fat.
Corn Silage .....	.009	.11	.007
Corn Stover .....	.017	.33	.007
Corn Fodder .....	.025	.35	.012
Slough Hay .....	.026	.42	.011
Timothy Hay .....	.028	.43	.014
Prairie Hay .....	.030	.42	.014

A careful study of the above table will enable one to readily classify the common farm feeds, which is of great advantage to the feeder. The grain feeds rich in protein, as a rule, cost more per pound than do the non-nitrogenous grain feeds. So it is usually desirable to feed as sparingly of them as possible and still supply the needs of the animals fed.

In glancing over the tables of nitrogenous and non-nitrogenous grain feeds, one will see that the proportion of protein to carbohydrates and fat is much larger in the former than in the latter. The same is true of the two classes of roughage.

**Feeds Compared.**—In comparing the grain feeds or concentrates with the roughage, one will see that a pound of grain usually contains more nutrients than a



Fig. 82.—Making Clover Hay. Clover should be grown and fed on every farm. It is a very cheap nitrogenous feed.

pound of roughage. As a rule there is an abundance of roughage on the farm for which there is little or no market, and there is always a market for the grains, hence there is a tendency to feed roughage largely and economize on grain. A reasonable amount of roughage is desirable, but an animal that is working cannot eat and digest enough of it to supply its needs, so it should have some grain. To feed only grain is not desirable, as it is expensive and does not supply enough bulk. The successful feeder must regulate the amount of each of these classes of feeds to supply the needs of the animals.

**Roughage.**—The kind of roughage fed determines the kind of grain that should be fed to make a good ration. For example, if one feeds a milch cow fodder corn, timothy or slough hay, which are non-nitrogenous feeds, and then feeds her corn or barley for grain, also non-nitrogenous, the cow will get too much carbohydrates and cannot eat enough to get the protein she needs. If clover hay is fed, which is nitrogenous in character, then corn or barley, non-nitrogenous feeds, may be used for a large part of the grain feed.

**Questions:**

1. Name the common farm feeds that would be classed in the nitrogenous group. In the non-nitrogenous group.
2. Which grain feeds cost more per pound, nitrogenous or non-nitrogenous?
3. Why should not a ration for a milch cow or a work horse consist entirely of roughage?

**Arithmetic:**

1. Find the number of pounds of protein, of carbohydrates and of fat in 10 lbs. of timothy hay, 10 lbs. of fodder corn and 7 lbs. of barley.
2. Find the number of pounds of protein, of carbohydrates and of fat in 20 lbs. fodder corn, 4 lbs. of bran and 3 lbs. of barley.
3. Find the number of pounds of protein, of carbohydrates and of fat in 18 lbs. of clover hay and 5 lbs. of corn.

**FEED REQUIREMENTS OF DAIRY COWS.**

**Food of Maintenance.**—It is well known that every animal requires a certain amount of feed for bodily maintenance, even though it may be doing no work. Feed is needed to keep up the body-heat, for digestion, and other functions of the body, and this is called food of maintenance.

It has been found that the requirements for maintenance are approximately the same for all animals of the same class and weight and kept under similar conditions.

The amount of feed required for maintenance has been determined by feeding, for several months, mature, idle animals kept under normal conditions, and by weighing the feed fed and weighing the animals, and by regulating the feed so that the various animals neither gain nor lose in weight.

Prof. T. L. Haecker, of the Minnesota Experiment Station, has found by extensive tests that .07 of a pound of protein (Pro.), .7 of a pound of carbohydrates (C. H.), and .01 of a pound of fat are required per hundred pounds live weight to maintain a cow not giving milk. If a cow weighs 1000 pounds (10 hundred pounds) she will require for maintenance .7 of a pound of Pro., 7 pounds of C. H., and .1 of a pound of fat; that is, ten times as much as the requirements for one hundred pounds.

**Nutrients Required.**—Prof. Haecker has found also that the more milk a cow gives the more feed she needs, and the richer the milk the more feed required to produce it. For the convenience of feeders he has compiled a table from which the following is taken. Any one knowing the weight of a cow and the amount and richness of her milk; can easily determine the amount of nutrients she needs for maintenance and to produce milk.

**Nutrients Required to Produce One Pound of Milk of a Given Per Cent of Butter-Fat.**

Per Cent Fat	Protein	Carbohydrates	Fat
3	.042	.19	.013
3.5	.045	.21	.015
*4	.048	.23	.016
4.5	.051	.25	.018
5	.054	.27	.019
5.5	.057	.29	.020
6	.060	.31	.022

From the above table it is an easy matter to determine the amount of nutrients required to produce a given number of pounds of milk of a given per cent of fat. For example, a cow that gives 15 pounds of 4 per cent milk will require, for its production, 15 times as much

of the nutrients as is required to produce one pound of milk of the same quality. (See star in table above.)

15x.048 lbs. Pro., .23 lbs. C. H. and .016 lbs. fat equals .72 lbs. Pro., 3.45 lbs. C. H. and .24 lbs. fat. Thus, it will be seen that a cow requires .72 lbs. Pro., 3.45 lbs. C. H. and .24 lbs. fat, simply for the production of milk. In addition to this, she must be supplied with feed for bodily maintenance. If the cow weighs 1,100 lbs. she will require 11 times .07 lbs. of Pro., .7 lbs. of C. H. and .01 lbs. of fat (the amount required to maintain 100 lbs. live weight) or .77 lbs. of Pro., 7.7 lbs. of C. H. and .11 lbs. of fat.

From the above facts, we know that a cow weighing eleven hundred pounds, and giving 15 pounds of 4% milk, requires daily:

	Pro.	C. H.	Fat.
For maintenance .....	.77	7.7	.11
For 15 pounds of 4% milk .....	.72	3.45	.24
Total daily requirement .....	1.49	11.15	.35

From the above it will be seen that to determine the requirements of a cow one must know approximately her weight, her daily milk production and its per cent fat. If these facts are known it is, with the use of the table, a very simple mathematical problem to determine her daily needs.

### Questions:

1. What do you understand by the term "food of maintenance?"
2. How have feeders found out how much feed animals require for maintenance?
3. Why does a cow require more feed when giving 20 pounds of 4% milk than when she is giving 10 pounds of 4% milk?
4. What three factors must be known in order to determine the daily feed requirements of a cow?

### Arithmetic:

1. For bodily maintenance a cow requires .07 lbs. of Pro., .7 lbs. of C. H. and .01 lbs. of fat per 100 lbs. live



weight. How many pounds of each nutrient are required to maintain a cow weighing 1050 lbs.?

2. If .051 lbs. of Pro., .25 lbs. of C. H. and .018 lbs. of fat are required to produce 1 lb. of 4½% milk, how many pounds of each nutrient are required to produce 18 lbs. of 4½% milk?

3. How much Pro., C. H., and fat will a 1050-pound cow giving 18 lbs. of 4½% milk require? See examples above.

#### TO COMPOUND A RATION.

**Proportion of Grain to Roughage.**—When one knows a cow's requirements it is a very simple matter, by using the table on page 198, showing the composition of feeds, to compound a ration that will supply them.

We have found that an eleven hundred pound cow giving 15 pounds of 4% milk daily requires daily 1.49 pounds of protein, 11.15 pounds of carbohydrates and .35 pounds of fat. A cow could not eat enough roughage to supply this amount of nutrient. She must have some more concentrated feed such as grain. Many dairymen feed grain in the proportion of 1 pound of grain to each 3 pounds of milk that the cow gives, and supply the rest of the nutrients required by feeding roughage. This is practically a safe basis. Thus the cow, whose record is given above, would require about 5 pounds of grain (as she gives 15 pounds of milk daily) and roughage to complete the ration.

**A Simple Ration.**—To compound a ration one must know the composition of various feeds to be fed. See table, page 198.

#### Daily Ration for an 1100 Pound Cow Giving 15 Pounds of 4% Milk Daily:

	Pro.	C. H.	Fat.
Corn, 4 lbs. ....	.316	2.67	.172
Bran, 1 lb. ....	.129	.40	.034
Clover Hay, 12 lbs. ....	.816	4.30	.20
Fodder Corn, 10 lbs. ....	.250	3.46	.12
<hr/>			
Total Nutrients .....	1.511	10.83	.526

It will be seen that this ration contains approximately the right amount of protein, for which no other nutrient may be substituted, but is a little deficient in carbohydrates. There is .17 pounds more fat than is required, which may be used to make up the shortage in carbohydrates. We have learned that fat and carbohydrates are used for the same purposes in the animal body, and that

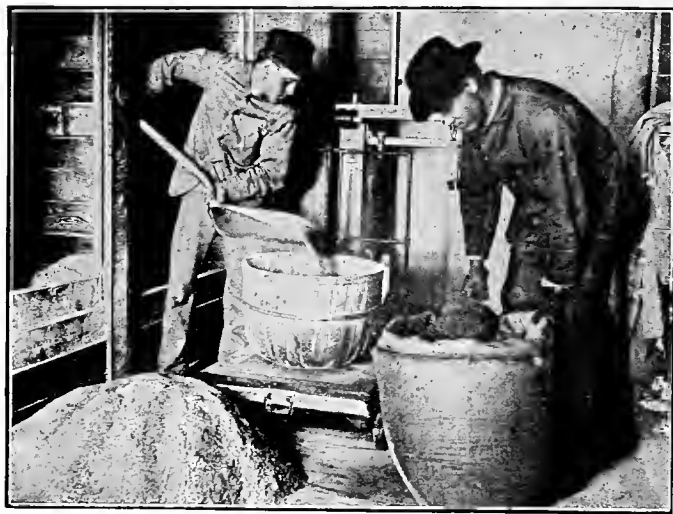


Fig. 83.—Mixing the Grain Feed. In this case 100 lbs. of bran and 400 lbs. of corn meal.

fat is worth 2.2 times as much as carbohydrates, hence the excess fat ( $.17 \times 2.2$ ) is equal to .37 of a pound of carbohydrates; which, added to the 10.83 pounds furnished by the ration, makes 11.20 pounds, or approximately what is required.

**Features of the Above Ration.**—It is not usually desirable to feed as large a proportion of corn to dairy cows as is provided by this ration, as corn has a tendency to produce fat rather than milk. But when clover

hay, which is rich in protein, is fed, a large proportion of corn or other non-nitrogenous grains may be used. When timothy, corn stover or wild hay, which are deficient in protein, are fed for roughage, a larger amount of bran or other nitrogenous grain would be required.

Since clover can be grown as cheaply as any hay crop, it is advisable to provide plenty of well cured clover hay for stock; for it makes possible the use of cheaper grain feeds, as corn and barley, instead of oats, bran and oil meal, which must be fed if non-nitrogenous roughage is used.

**Feeding a Ration.**—To feed a cow such a ration it is not necessary to weigh each day 4 pounds of corn, 1 pound of bran and the hay and fodder. One would mix 100 pounds, or more, of bran with 4 times as much corn. In feeding, use a measure that holds the desired number of pounds of the mixture. By weighing the hay and corn fodder a few times, one would soon be able to feed approximately the right amount of each without weighing it.

**Questions:**

1. In what way can one determine approximately the amount of grain needed by a cow?

2. Tell how you would proceed to compound a ration for a cow.

3. Would you weigh out the ration each time you feed a cow?

**Arithmetic:**

1. What is the cost of a ration composed of 4 pounds corn at 50c. per bu. (56 lbs.), 1 lb. bran at \$20 per ton, 12 lbs. clover hay at \$5.00 per ton, and 10 lbs. corn fodder at \$4.00 per ton?

2. A cow fed the above ration gives 15 lbs. of 4% milk. What is the milk worth when butter-fat is selling for 30c. per pound?

3. How many pounds of protein in one ton of bran? What does it cost per pound when bran costs \$20 per ton?

4. How many pounds of protein in one ton of clover hay? What does it cost per pound when clover hay costs \$5.00 per ton?

### Rations Continued.

**Figuring Rations.**—From the table given on page 201 any person who understands decimals will have no difficulty in determining the amount of protein, carbohydrates and fat required by a cow whose weight, milk flow and quality of milk are known. Likewise one knowing the requirements of a cow and the composition of feeds, as given on page 198, can as easily determine the mixture of the various feeds required to supply the needs of the cow.

**A Poor Ration.**—A very common ration fed to dairy cows on the farm is composed of slough hay, corn stover, and ground barley and corn. Suppose a 1,000 lb. cow gives 20 lbs. of milk testing 4.5% fat. She will require:

	Pro.	C. H.	Fat.
For maintenance.....	.7	7.	.1
For 20 lbs. of 4.5% milk .....	1.02	5.	.36
Total requirements .....	1.72	12.	.46

A cow giving 20 lbs. of milk would require seven or eight pounds of grain. Let us see what kind of a ration she would get if fed the above mentioned feeds:

#### Daily Ration for a 1000 lb. Cow Giving 20 lbs. of 4.5% Milk.

		Pro.	C. H.	Fat.
Corn .....	4 lbs.	.316	2.67	.172
Barley .....	3 lbs.	.261	1.98	.048
Slough hay .....	12 lbs.	.312	5.03	.132
Corn Stover .....	12 lbs.	.204	3.93	.084
Total nutrients .....		1.093	13.61	.436

This ration would be all a cow could possibly eat, as it supplies 31 lbs. of dry feed, yet it comes far short of supplying enough protein. We have learned that neither carbohydrates nor fats can take the place of protein. A cow must have sufficient protein or she cannot maintain her body or produce milk. It is not to be wondered at,

then, that a cow fed a ration similar to the above would gradually decrease in her milk flow until her requirements balanced the protein she was getting. She would then get more carbohydrates (fat-forming feed) than needed for milk production, and so would begin to fatten up, which is very undesirable in a milch cow while giving milk.

**A Good Ration.**—The required nutrients for the cow mentioned above could be supplied by replacing 3 lbs. of the corn or barley with 3 lbs. of oil meal (try it), but such a ration would be more expensive and no better than if the 12 lbs. of slough hay and 7 lbs. of the corn stover were replaced with 16 lbs. of clover hay. This would make a good ration and supply the need of the cow.

**Daily Ration for a 1000 lb. Cow Giving  
20 lbs. of 4.5% Milk.**

		Pro.	C. H.	Fat.
Corn .....	4 lbs.	.316	2.67	.172
Barley .....	3 lbs.	.261	1.98	.048
Corn stover .....	5 lbs.	.085	1.64	.035
Clover hay .....	16 lbs.	1.09	5.73	.270
<hr/>				
Total nutrients .....		1.752	12.02	.525

This ration emphasizes the fact that every farmer should provide plenty of good clover hay for his cattle.

**Questions:**

1. Can you tell what is wrong with the ration given under the head "A poor ration"?
2. Why would a cow be unable to keep up her flow of milk if fed such a ration?
3. Why is the ration given under the head "A good ration" better than the other?

**Arithmetic:**

1. Find the cost of the grain in the above ration, 4 lbs. of corn and 3 lbs. of barley. (Corn 50c. per bu., 56 lbs. and barley 50c. per bu., 48 lbs.).

2. Find the cost of a similar ration if 3 lbs. of corn were replaced with 3 lbs. of oil meal, making the grain ration 1 lb. corn, 3 lbs. oil meal and 3 lbs. of barley. (Oil meal costs \$35.00 per ton.)

3. What is the entire cost of the last ration given, corn 50c. per bu., barley 50c. per bu., clover hay \$5 per ton and corn stover \$3 per ton?

4. Find the requirements of a 1200 lb. cow, giving 35 lbs. of milk testing 3.5% fat.

#### SUCCULENT FOOD FOR DAIRY COWS.

**Kind of Ration.**—On page 203 a ration was suggested for an eleven hundred pound dairy cow giving 15 pounds of 4 per cent milk. This ration consisted of 4 pounds of corn meal, 1 pound bran, 12 pounds clover hay and 10 pounds fodder corn. It supplied all of the nutrients in the proportion needed by the cow, and if the cow was made comfortable and regularly fed and milked, she would do fairly well. Such a ration is more economical and will give better returns than will the ordinary ration of timothy or wild hay, corn stover and some of the common farm grains, as barley or corn.

**Cows Need Succulent Feed.**—We know that cows usually give the largest amount of milk when they are in good pasture. Their chief feed is then green grass. This would indicate that such feed is better for milk production than are the dry feeds fed in winter. Green feed is more easily digested than is dry, coarse fodder, such as hay, fodder corn and corn stover. Moreover less energy is required to digest it, it tends to keep the body and digestion in better condition, and it stimulates the appetite. We know this from our own experience. In the winter, when fresh vegetables are scarce and we eat potatoes, bread and meat for a long time, we become tired of them and crave for something succulent, as fruit and green vegetables. In well regulated homes such food is supplied by canned or fresh vegetables and fruits. The barrel of apples in the cellar is not exceedingly valuable from the standpoint of amount of nourishment

contained. The great value of the apples is due to the fact that they aid in toning up the whole system, and satisfy the craving for something succulent. In like manner it pays to supply the live stock on the farm with something to take the place of the green grass they get in the summer. The whole ration need not be of succulent



Fig. 84.—Filling a silo at University Farm. Corn is cut while still green, when ears are well glazed, hauled directly, cut and put in the silo. Silage does not spoil, because air is kept away from it. It is still green and succulent when fed.

material, but a portion of it is quite essential to best results. Just as an apple or two each day is good for a boy or girl, so are a few pounds of succulent feed (such as roots or silage) each day good for farm animals.

**Ensilage** is one of the cheapest succulent feeds that can be supplied to farm animals during the winter. That is, when one has a large herd and is able to build the silo and buy the necessary machinery for handling the crop. It is good feed, handy to feed and very much relished by all classes of stock.

Ensilage is usually corn, (sometimes other crops), stored green in

a large tank called a silo. The silo must be air tight or nearly so, as the green feed is kept from spoiling by keeping the air away from it—just as berries are kept in fruit jars.

**Roots.**—Another way by which succulent feed may be supplied is by raising roots, as mangels, rutabagas,

stock carrots, etc. For small herds, roots are cheaper than ensilage, as no expensive machinery or storage room is required. By planting roots on rich land, 15 to 20 tons may be grown per acre. One-half to two acres of roots well cared for will supply a herd of from 8 to 12 cows with the succulent feed needed.

### Questions:

1. Why do cows usually give more milk in summer than in winter?
2. What is the difference in their feed in summer and winter?
3. What do animals need in winter in addition to dry feed?
4. How may succulent feed be supplied to animals in winter?
5. To what conditions is ensilage better adapted than mangels?
6. What do people eat in winter to supply succulent food?

### Arithmetic:

1. If corn contains 89% dry matter and mangels contain 9% dry matter, how many pounds of mangels are required to supply as much dry matter as is supplied by 5 pounds of corn?
2. If mangels contain 9% dry matter, how many pounds of water in 100 pounds of mangels?
3. If mangels yield 20 ton per acre, how many tons of dry matter are produced per acre? (Mangels are 9% dry matter).

### RATIONS CONTAINING SUCCULENT FEED.

**Composition of Feeds.**—To intelligently compound rations with ensilage or roots forming a part, it is necessary to know the amount of digestible nutrients in the various feeds used. The following table gives the composition of the feeds used in the two rations to be compounded.



## Digestible nutrients in 1 lb. of feed:

	Protein.	Carbohydrates.	Fat.
Corn meal .....	.079	.67	.043
Bran .....	.129	.40	.034
Clover hay .....	.068	.36	.017
Fodder corn .....	.025	.35	.012
Corn silage .....	.009	.11	.007
Mangels .....	.011	.05	.001

A glance at the above table will show that a pound of corn silage contains about one-third as much digestible nutrients as does fodder corn.

This is due to the fact that the ensilage has practically as much water in it as when it was cut green in the field, while the fodder corn has been dried out (cured). In other words 3 pounds of green corn, cut and shocked in the field, will dry out and make about one pound of fodder corn. We would need, then, to feed about three times as many pounds of ensilage as of fodder corn to get the same amount of nutrients. But ensilage has the additional value of stimulating digestion and keeping the animal in a good healthy condition.

**Ration Containing Ensilage.**—The ration suggested on page 203, for an 1100-pound cow giving 15 pounds of 4 per cent milk, as suggested, consisted of 4 pounds corn meal, 1 pound bran, 12 pounds clover hay and 10 pounds fodder corn. This supplied approximately the nutrients needed by the cow, which are 1.49 pounds protein, 11.15 pounds carbohydrates and .35 pounds fat.

**Ration, Containing Ensilage, for an 1100 Pound Cow  
Giving 15 Pounds of 4 Per Cent Milk.**

		Protein.	Carbohydrates.	Fat.
Corn meal .....	4 lbs.	.316	2.67	.172
Bran .....	1 lb.	.129	.40	.034
Clover hay .....	12 lbs.	.816	4.30	.200
Corn silage .....	30 lbs.	.270	3.40	.210
<b>Total nutrients .....</b>		<b>1.531</b>	<b>10.77</b>	<b>.616</b>

It will be noticed that the above ration furnishes approximately the nutrients required. It differs from the ration given on page 203 only in containing 30 pounds of corn ensilage in place of 10 pounds of fodder corn. So far as nutrients are concerned, there is very little difference, but a cow would give better returns on this ration than on the former, owing to the succulence added by the ensilage, which makes the whole ration more palatable and more easily digested.

**Ration Containing Roots for an 1100-Pound Cow  
Giving 15 Pounds of 4 Per Cent Milk.**

		Protein.	Carbohydrates.	Fat.
Corn .....	4 lbs.	.316	2.67	.172
Bran .....	1 lb.	.129	.40	.034
Clover hay ....	10 lbs.	.68	3.60	.170
Mangels .....	20 lbs.	.220	1.10	.02
Fodder corn ...	9 lbs.	.225	3.11	.108
		<hr/>		
Total nutrients .....		1.570	10.88	.504

It will be seen that mangels contain a little more protein than does ensilage, but very much less of carbohydrates and fat. They do not provide so much nutrients per pound as does the ensilage, but are a little more valuable as a means of furnishing succulence, as they are sweet, while ensilage is more or less sour.

To get enough carbohydrates in this ration, it was necessary to add some fodder corn. A ration containing both clover hay and fodder corn can usually be balanced by changing the proportion of these two feeds. Fodder corn is rich in carbohydrates and clover hay is rich in protein.

**Questions:**

1. How do fodder corn and corn silage compare in feeding value?

2. For what reason is a ration containing ensilage better than one containing only cured roughage?

3. In what respect do mangels and ensilage differ?

**Arithmetic:**

1. Find the daily requirements of Pro., C. H., and fat for a 1000-pound cow giving 20 pounds of 4 per cent milk. See page 201.

2. Find the amount of Pro., C. H., and fat in 5 pounds of corn meal, 2 pounds of bran, 12 pounds of clover hay and 9 pounds of fodder corn. (See page 198.)

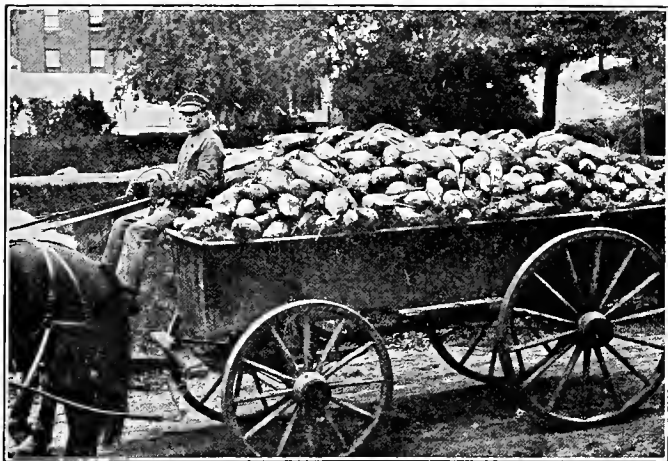


Fig. 85.—A load of mangels. Mangels may be grown at from \$1.60 to \$2.00 per ton. They are a very valuable addition to the dry feeds commonly fed in winter, as they are palatable and succulent.

3. Find the amount of Pro., C. H., and fat in a ration the same as the above, but replace the 9 pounds of fodder corn with 27 pounds of corn ensilage.

4. Find the amount of fodder corn and mangels required to furnish about the same amount of nutrient as 27 pounds of silage.

## HORSE LABOR.

**Cost of Farm Products.**—A very considerable item in the cost of producing farm products is horse labor. When one owns the horses used on the farm, it may seem that horse labor costs very little, but a careful consideration of facts as they exist will convince one that the cost is there and that it is sufficiently large to be worth careful consideration.

If one hires a horse for several days and must pay 75 cents per day for him, he may think he is paying too much, but careful accounts show that the actual cost of horse labor on the farm is about 8 cents per hour, or 80 cents for a ten hour day, even when the horses are owned on the farm.

**The Cost of Horse Labor** has been determined by the Minnesota Experiment Station, in co-operation with the U. S. Department of Agriculture, by keeping accurate records on twenty-four Minnesota farms for six years. These records show that the total cost of keeping a farm work-horse for a year averages about \$84.00, and that the average number of hours of work done by each horse is about 1000 per year; making the cost per hour of work 8.4 cents.

To one who has given the matter little thought, the above figures seem high, but when one considers that the cost of a horse for a year includes several items it becomes plain that the figures are not far wrong. The following items are the important ones in the cost of keeping a horse: feed, labor for caring for him, depreciation, interest on investment, shelter, shoeing, and depreciation and repair on harnesses. While it is not easy to figure all of these items without having kept accurate records for a considerable time, yet a fairly accurate estimate may be made by noting about the amount of hay and grain fed per day in winter and in summer, and its value; the amount of time spent each day in caring for the horses; the value of the horses and on this value figuring the interest and depreciation; and

then adding to these items a fairly liberal estimate of the cost of shelter, harnesses and shoeing. The total amount will no doubt be a surprise.

The cost of horse labor on the farm may be reduced by raising more horses on the farm, by keeping fewer work horses, by economical feeding and by better planning of the work.

**Raising More Horses.**—By raising more horses on the farm, most of the farm work may be done with mares that raise colts, and with young horses before they are old enough to sell to advantage. In this way the horses will be doing double duty. The item of depreciation will be largely eliminated; also a part of the cost of feed, because at least a portion of the feed fed to the mares will be paid for out of the value of the colts.

**Fewer horses** can often be kept, with little inconvenience in doing the farm work. When one realizes that it costs \$70 to \$90 per year to keep a horse, he may find that often an extra horse may be hired for a few days, during seeding or harvest, cheaper than to keep one a whole year when it is really needed but a very short time.

**Distribution of Horse Labor.**—One can often greatly reduce the demand for horse labor at special seasons, and distribute it over a longer season, by following a diversified system of farming. If a part of the farm is seeded to grass there is less plowing and seeding to be done. If corn is raised on a part of the land, instead of seeding it all to grain, the seeding and harvesting periods are both made longer, so the same amount of land can be handled with less horse labor.

**Have Plenty of Horses.**—It is important, however, to have plenty of good, strong horses with which to do the farm work, because with good horses one can do more work in a day than with poor ones, and thus save man labor, which is also costly. It is easier to keep good hired men if one has good horses. The good farm manager will consider the question from both sides and act accordingly, but he cannot act wisely unless he knows all the facts.

**Questions:**

1. Name some of the items that must be considered in determining the cost of keeping a farm work horse.
2. Give four ways by which the cost of horse labor may be reduced on the farm.
3. Give at least two reasons why plenty of good horses should be kept on the farm.

**Arithmetic:**

1. If a horse is fed 2 qts. of oats three times a day half the year and 4 qts. three times per day for the balance of the year, how many bushels of oats will he be fed in a year? How much are they worth at 35 cents per bushel?
2. If a horse is fed 15 pounds of hay per day, how many tons will he be fed in a year? How much is it worth at \$6.00 per ton?
3. If a man spends 1 hour per day caring for 4 horses, how much time will he spend in a year? How much time is this per horse? How much is this labor worth at 14 cents per hour?

**FEEDING HORSES.**

**Feed** is the greatest item of expense in keeping a horse. This fact, together with the fact that there are many different ways of feeding and kinds of feed, makes it evident that in the feeding of horses is a great opportunity of waste or saving. The average cost of feed (hay or grain) for a farm work horse has been found by the Minnesota Experiment Station to be about \$50.00 per year. If one is keeping several horses, there is an expenditure sufficiently large to be worthy of consideration.

**Use of Feed.**—A horse requires feed to maintain his body, to replace muscles broken down by work, and to supply the energy necessary to perform the work.

**Concentrated Food.**—A horse has but one stomach and that is not nearly so large as the stomach of a cow. On this account a horse cannot eat as much roughage

(hay and fodder) as a cow can, and must have a larger proportion of concentrated feed, as corn, oats, etc. Another reason why a horse needs a larger proportion of grain than do cattle is that they have not as much time to eat as cattle have.



Fig. 86.—Harvesting. Horses working in the harvest field need concentrated feed at noon especially because they haven't time to eat enough hay.

A horse at work is busy for about ten hours each day. You probably have noticed that they spend a great deal of time at night eating. They can get much more nourishment in a short time when eating grain than if eating hay. Four pounds of

oats, which is a fairly good feed for a horse, contains .37 pounds of protein, 1.89 pounds of carbohydrates and .17 pounds of fat. Four pounds of timothy hay contains .11 pounds of protein, 1.74 pounds of carbohydrates and .06 pounds of fat. A horse can eat four pounds of oats in ten to twenty minutes, while it would take him about an hour to eat four pounds of hay.

At noon a work horse seldom has a chance to eat as much as he wants, but if he has a good feed of grain, he can come more nearly getting what he needs than if he is fed only hay.

**More Grain Than Roughage.**—For the reasons given above, a good ration for a horse at heavy work must contain more grain than roughage by weight; while a good ration for a milch cow will contain fully twice as much roughage as grain.

Roughage is a much cheaper form of feed than is grain. For example, oats at 32c. per bushel cost 1c. per pound; while hay at \$5.00 per ton costs but 1c. for four pounds. The above prices are about the average farm prices for these feeds for the last ten years.

Since a horse at work must have a large proportion of grain, it is very important that one try to feed as cheap a form of grain as possible and get the desired results.

**Oats and Corn.**—The favorite feed for horses is oats and timothy hay. The average cost of oats per pound for the past ten years has been about 1c., while the average cost of shelled corn has been about 2-3c. per pound. The grain feed alone for a horse costs about \$50.00 per year. If corn can be used to replace all, or a part of, the oats, a considerable saving can be made.

We have learned that there are two general classes of feed; nitrogenous or muscle forming feeds, and non-nitrogenous or fat and heat forming feeds. Most of the common farm feeds have both nitrogenous matter (protein) and non-nitrogenous matter (carbohydrates), but the proportion of these compounds varies.

The most common feeds we have, that have a comparatively large amount of protein, are bran, oats, clover and alfalfa hay. The feeds containing large quantities of carbohydrates are corn, barley, timothy or wild hay, and corn fodder. In the grain feeds, those containing a large proportion of protein are more expensive than those rich in carbohydrates; while in the roughage, clover hay, which is rich in protein, is cheaper than timothy, which is very poor in protein. These facts make it evident that the needed protein may be furnished in roughage more cheaply than in grain.

**Corn and Clover Hay.**—If corn is to replace oats as the grain feed for horses, some feed rich in protein must be used for roughage. Clover is the cheapest form of roughage that can be produced on the farm, and is rich in protein. There is a general belief among horsemen



that clover hay is not good for horses. This is true of poor and dusty clover hay; but good, bright, well cured clover hay, fed in moderation, is a very good kind of hay for horses.

Recent experiments at the Ohio Experiment Station have shown that horses fed mixed timothy and clover hay, kept just as well, were able to do just as much work and showed just as good spirit, when fed corn as



Fig. 87.—A field of alfalfa hay curing under canvas caps. Many people who are anxious to get a good quality of clover or alfalfa hay, cover the cocks with canvas caps to protect the hay from dew and rain.

when fed oats, and that a pound of corn on the cob was worth as much for horse feed as a pound of oats. If horses can be fed corn and clover hay without detriment to them, the cost of keeping a work horse can be reduced from \$10.00 to \$20.00 per year. This is worthy of study and a fair trial.

### Questions:

1. Can you give any way by which the cost of feed for a horse may be reduced without injury to the horse?
2. What can you say of the relative value of corn and oats as feed for horses, and the cost per pound of each.
3. Compare timothy and clover hay as to their feeding value.

**Arithmetic:**

1. If corn is worth 40c per bushel, what is the cost per ton of shelled corn (56 lbs. per bushel)? Of ear corn (72 lbs. per bushel)?

2. If it costs \$10.44 per acre to grow a crop of corn and husk it from the standing stalks, what does it cost to produce a bushel of corn when it yields 40 bushels per acre? How much does such corn cost per ton of shelled corn? Per ton of ear corn?

3. If it costs \$7.00 per acre to produce a crop of 2 tons of clover, how much does it cost per ton to produce clover hay?

**FEEDING HORSES CONTINUED.**

**A Ration** for any animal is said to be balanced when it supplies in the right proportion the nutrients needed by the animal to maintain its body and to perform the work it is expected to do. It is very important to know the requirements of different animals and the composition of different feeds, so one can combine the feeds at hand in such a way as to make the best use of them. A ration is figured on the basis of what an animal needs for one day.

**Requirements of a Horse.**—A balanced ration for a horse at hard work must contain digestible nutrients in approximately the following amounts: .18 lbs. protein (Pro.), 1.2 lbs. Carbohydrates (C. H.), and .05 lbs. of fat, per 100 lbs. live weight of horse. Thus a horse weighing 1,000 lbs. requires, when at hard labor, 1.80 lbs. of Pro., 12.0 lbs. of C. H. and .5 lbs. of fat.

**Digestible Nutrients in 1 lb. of the Common Farm Feeds.**

Grain Feed.	Pro.	C. H.	Fat.
Corn .....	.079	.667	.043
Barley .....	.087	.656	.016
Oats .....	.092	.473	.042
Bran .....	.129	.401	.034
<b>Roughage.</b>			
Tim. Hay .....	.028	.430	.014
Slough Hay .....	.026	.420	.011
Clover Hay .....	.068	.360	.017
Oat Straw .....	.012	.386	.008

**Combination of Feeds.**—The proper combination of the feeds requires some thought and some figuring, but is a work that should be done on every farm or anywhere that horses are fed grain. Only by studying the feeding value of the different feeds, and their prices, can one be sure he is feeding his horses the most economical ration. Sometimes it pays one to sell the feeds he may have on hand and buy others in which the nutrients can be obtained more cheaply. As the market prices of the different feeds are changeable, one has a constantly varying problem. The wide awake feeder always has something to think about that is worth while.

**Rations for a 1,200 lb. Horse at Heavy Work.**—A 1,200 lb. horse at heavy work requires 2.16 lbs. of Pro., 14.40 lbs. C. H., and .60 lbs. of fat.

The following rations will approximately supply these requirements:

#### Ration No. I

	Pro.	C. H.	Fat.
Oats, 18 lbs. ....	1.65	8.46	.75
Timothy Hay, 14 lbs. ....	.39	6.08	.19
Total Nutrients .....	2.04	14.54	.94

#### Ration No. II

	Pro.	C. H.	Fat.
Corn, 15 lbs. ....	1.18	10.00	.64
Clover Hay, 14 lbs. ....	.95	5.02	.24
Total Nutrients .....	2.13	15.02	.88

#### Ration No. III

	Pro.	C. H.	Fat.
Corn, 10 lbs. ....	.79	6.69	.43
Bran, 7 lbs. ....	.90	2.81	.24
Tim. Hay, 14 lbs. ....	.39	6.08	.19
Total Nutrients .....	2.08	15.58	.86

Each of the rations given above supplies approximately the needed amount of each of the digestible

nutrients, also nearly the same amount of bulk. One may reasonably conclude that, of these rations, the one that can be most cheaply and conveniently supplied will be satisfactory. A little figuring will convince any one that there is a considerable saving by feeding ration No. II over feeding No. I, and that usually No. III will be cheaper than No. I.



Fig. 88.—Corn in shock. Bundle corn is one of the cheapest feeds grown. (See page 218.)

If one is feeding a heavy ration, as one of the above, the grain should be reduced considerably if a horse is to stand idle for a few days.

A change of feed occasionally is probably better than to feed continually any one ration, as an animal appreciates a change of diet fully as much as a man does. An occasional feed of bran, when horses are fed timothy hay and oats, is a great benefit to a horse, as it aids in regulating his bowels. The addition of clover hay to the ration cheapens it, and adds greatly to its value if the clover hay is bright and well cured. Some feeders are prejudiced against clover hay for horses, but good clover hay fed in moderation is a very desirable kind of feed for them.

Clover hay is more cheaply grown than timothy hay, because it yields more per acre. It has the additional advantage over timothy of being of much more benefit to the land on which it is grown.

**Questions:**

1. What do you understand by a balanced ration?
2. State the requirement, in digestible nutrients, of a horse at hard labor.
3. What can you say regarding the proper combination of feeds for horses?

**Arithmetic:**

1. If oats are worth 35c per bu. and timothy hay is worth \$6.00 per ton, what is the cost of Ration No. I?
2. If corn is worth 40c per bu. (56 lbs.) and clover hay is worth \$6.00 per ton, what is the cost of Ration No. II?
3. If bran is worth \$24.00 per ton, corn 40c per bu., and timothy hay \$6.00 per ton, what is the cost of Ration No. III?

**FEEDING HORSES WHEN IDLE.**

**Idle Horses.**—Farm horses are idle or do very little work for a considerable portion of the year, and when they are idle one can greatly reduce the amount of grain they get and increase their allowance of hay. They do not need so much to eat, because they are expending very little energy. They have plenty of time to eat roughage, and as roughage is cheaper than grain it cheapens the ration very much to be able to reduce the proportion of grain. The larger amount of roughage helps to satisfy the horse without giving him more nourishment than he needs.

**Maintenance.**—All that a mature horse needs when idle is enough to maintain his body.

This is called a maintenance ration. If the horse is poor when the fall work is finished, he will need enough more than the maintenance ration to enable him to add to his weight the amount necessary to get him up to the desired condition. A young horse, three to five years old, is still growing, and will need enough more than a maintenance ration to enable him to supply the needs of his body in growing.

There is always some team work to do on the farm in the winter; and if several horses are kept, a part of them may be used for the winter's work and fed accordingly. The rest of the horses should be kept over as cheaply as possible and yet maintain them in fair condition.

If kept comfortable, horses will do very well on just hay, preferably clover, and corn stalks. If it is desired to increase their weight, a little bundle corn may be fed in place of the stalks. Clover hay and bundle corn



Fig. 89.—A good team of farm mares at work. If much of the farm work is done with mares, and they are allowed to raise colts, the cost of horse labor can be materially reduced.

make one of the cheapest farm rations for wintering horses.

**Ration of Bundle Corn and Clover.**—Corn may be grown, cut, shocked and hauled in from the field for about \$10.00 per acre. If it yields 40 bu. per acre, there will be 2240 lbs. of corn and probably about 3000 lbs. of corn stalks. These corn stalks are not the best kind of feed, as they are too mature to be easily digested; but they add bulk to a ration. Maintenance requirements for horses have not been so carefully worked out as for cattle, and standards vary from .06 to .07 pounds of protein and .6 to .7 pounds of carbohydrates per 100 lbs.

live weight of horse. A 1200 lb. horse requires when idle about .8 lb. of protein, 8 lb. carbohydrates and .1 lb. of fat. The following combinations of common farm feeds will be found to supply about the nutrients needed.

### Digestible Nutrients in 1 lb. of Feed

	Pro.	C. H.	Fat.
Oats .....	.092	.473	.042
Corn .....	.079	.667	.043
Corn stover .....	.017	.328	.007
Clover Hay .....	.068	.358	.017
Timothy Hay .....	.028	.434	.014

### Ration No. 1

Timothy Hay, 15 lbs. ....	.42	7.01	.21
Oats, 4 lbs. ....	.368	1.89	.168
	<hr/>		
	.788	8.90	.378

### Ration No. 2

Corn stover, 15 lbs. ....	.255	4.92	.105
Clover hay 8 lbs. ....	.544	2.84	.136
	<hr/>		
	.799	7.76	.241

### Ration No. 3

Bundle corn, 14 lbs. ....	.610	5.626	.314
Mixed hay, 8 lbs. ....	.384	3.168	.124
	<hr/>		
	.994	9.794	.438

Ration No. 1 represents a very common ration for idle horses. This ration would be changed very little if good slough hay or upland hay were used in place of the timothy. Ration No. 2 is a little cheaper than No. 1, and will give good results if both the stover (corn stalks from which ears have been husked) and clover are good.

Ration No. 3 provides more nutrients than the others, and will supply the needs of a 1200 lb. horse that is growing or gaining in weight, or maintain a horse that is doing some light work about the farm, as hauling straw or manure for a few hours occasionally. It is as-

sumed that 14 lbs. bundle corn contain 6 lbs. of corn and 8 lbs. of corn stover, and that the mixed hay is half clover and half timothy.

**Questions:**

1. Why do horses require less when idle than when at work?

2. What is meant by a maintenance ration?

3. What can you say regarding some economical combinations of feed for idle horses?

**Arithmetic:**

1. What is the cost of Ration No. 1, if timothy hay is worth \$6.00 per ton and oats are worth 35c per bu.?

2. What is the cost of Ration No. 2, if corn stover is worth \$3.00 per ton and clover hay is worth \$6.00 per ton?

3. What is the cost of Ration No. 3, if bundle corn costs \$4.00 per ton and mixed hay is worth \$6.00 per ton?

**SHEEP.**

**Place on the Farm.**—A study of sheep, their nature and habits, indicates that they may be worthy of more consideration than they at present receive. Sheep are so constituted that they can eat and thrive on a diet consisting chiefly of roughage. In this respect they are similar to cattle and very different from hogs. Hogs have a comparatively small stomach, and the greater portion of their ration must be grain.

There is always a ready market for grain, though as a rule it is not well to make a practice of selling a great deal of grain from the farm. In selling grain from the farm one is constantly losing fertility. If the grain can be fed and the live stock product sold for as much or more than the value of the grain, it is well to do this, because by so doing most of the fertility contained in the grain is kept on the farm in the form of manure.

**Live on Waste Products.**—In addition to the grain produced on a farm, there is always more or less roughage, as straw, corn stalks, hay; also scattered grain in the fields, weeds, etc., for which there is no market. It is



therefore without value unless there is some class of stock kept that can eat it. Much of this coarse stuff is not suitable for dairy cows. Beef cattle can use such feed, but in some respects sheep are more likely to return a profit on such feed than are beef cattle. First, sheep produce two crops each year, a crop of wool and a crop of lambs. In many cases the crop of wool is sufficient to pay for the feed for a sheep during the entire year, which leaves the lamb crop clear. Second, a lamb is ready for market when from 6 months to 1 year old, while a calf is usually unfit for sale until from 2 to 3 years old; so sheep bring quicker returns.



Fig. 90.—A Shropshire ram. The Shropshire is a very popular type of sheep.

### **Require Little Labor.**

—Most of our farms need more stock than is at present kept on them. Farm labor is so scarce that it seems unwise, on the average farm, to increase the number of cows kept, beyond what can be cared for, if necessary, by the family. Sheep require comparatively little labor, except for a short time during the lambing season. Five

to seven ewes will bring in about as much income in a year as a cow, and less labor is required to care for them. In view of these facts, the live stock of the farm may often be more easily and more profitably increased by putting on a flock of from 20 to 70 ewes than by adding from 3 to 10 cows to the herd.

**Shelter.**—Sheep are so well protected by their wool that they need very little or no protection from the cold. They should, however, be kept dry and have a place, that is free from draughts, in which to lie down. A single board or straw shed, closed tight on three sides, but with

the other side partly open so the sheep may run out and in at will, is a very satisfactory place in which to keep sheep. If lambs are to come during the cold weather, warm quarters must be provided.

**Fencing for Sheep.**—One of the objectionable features of keeping sheep on the average farm is the difficulty of fencing them in. A fence that can be built for 20 cents to 25 cents per rod is satisfactory for cattle. A much closer fence, as a woven wire fence or a narrow ribbon of woven wire with one or more barbed wires above, is needed for sheep. Such a fence costs 45 to 60 cents per rod. However, as farms are more intensively farmed, more and better fences will be used, and then there will be no difficulty in keeping sheep.

**Feeding Sheep.**—A number of farmers, who have not the necessary fencing so they can raise sheep to advantage, have gotten some of the benefits of having sheep on their farms by buying at about harvest time a carload of lambs, or as many as they can handle to advantage, and allowing them to graze over their stubble and corn fields during the fall. Such sheep are in fine condition to fatten during the winter, on bundle corn or other cheap feed. This practice has enabled these farmers to produce several pounds of mutton on each acre of land, after it has produced a crop; to make their land cleaner and richer; and to feed on the farm, at a profit, products otherwise of little or no value.

### Questions:

1. What are some of the farm products that may be utilized to advantage by sheep, but are of little or no value for hogs or cows?
2. Compare the shelter needed for sheep with the shelter needed for dairy cows.
3. What can you say about fencing for sheep?
4. In what way do sheep return two crops each year?

### Arithmetic:

1. A farmer buys 50 sheep at \$4.50 each. How much do they cost him?

2. When shorn, the 50 sheep average  $7\frac{1}{2}$  lbs. of wool each. How many pounds of wool will the farmer have? How much is it worth at 24c per pound? How much is the wool worth per sheep?

3. From the 50 sheep the farmer raises 45 lambs worth \$4.00 each. How much are the lambs worth? What is the average income for lambs from each of the 50 sheep?

#### FEEDING SHEEP.

**Care and management** have quite as much to do with successful sheep husbandry as with the successful management of any kind of live stock. While sheep may be able to live with less attention and shelter than are required by other classes of live stock, they will not prove profitable unless made comfortable and given attention when needed.

During the winter the flock on the average farm consists chiefly of ewes kept over winter with the expectation that they will have lambs in the spring.

**Winter Care of Breeding Ewes.**—Ewes kept on good pasture during the summer and fall, are usually in good flesh by the time they are put in winter quarters. During the winter they need food enough to maintain their bodies, to provide for the growth of wool and to supply the energy needed for what little exercise they take about the shed and yards. They do not need to be fed as heavily in proportion to their weight as cows that are giving milk, horses that are working, or cattle, sheep or hogs that are being fattened.

It is unwise to feed ewes any ration that will tend to fatten them. They should be fed succulent and muscle-forming foods, as clover hay, corn fodder, roots; and if fed any grain it should be of the kind rich in protein, as bran, oats, etc.

To properly feed sheep is as much of a problem as to properly feed other kinds of stock. If sheep are not well nourished, they will lose some of their wool, and be

weak and poor in the spring. If breeding ewes are fed too much, the lambs are liable to come weak in the spring; besides, there is an unnecessary waste of feed.

**Rations for Breeding Ewes.**—Some sheep feeding work done by the Animal Husbandry Division of the Minnesota Experiment Station, shows that with the common and cheap farm feeds, breeding ewes may be wintered with excellent results and very cheaply.



Fig. 91.—A good flock of breeding ewes gleaning in a stubble field. They will pick up all heads of scattered grain, as well as destroy many troublesome weeds.

The rations given below show the amount of the different feeds fed per day per 100 pounds live weight of sheep:

**Ration No. 1.**

3.7 pounds of fodder corn, in which there were a few nubbins of corn.

**Ration No. 2.**

3.7 pounds of 2d crop clover hay.

**Ration No. 3.**

1.5 pounds 2d crop clover hay, .1 pound corn fodder, and .3 pounds of oats and corn, equal parts.

**Ration No. 4.**

1.8 pounds 2d crop clover hay, 1.5 pounds roots, and .3 pounds of shelled corn.

**Ration No. 5.**

2.6 pounds of fodder corn, 1.5 pounds roots, and .3 pounds of oats and shelled corn, equal parts.

**Ration No. 6.**

2 pounds oat straw, 1.6 pounds roots, .6 pounds of bran and oats, equal parts.

**How to Feed Above Rations.** A glance at the above rations gives one an idea that it would be impractical to weigh out feed so carefully to each sheep; which, of course, is true. To feed any of the above rations, one would simply need to know the number of ewes to be fed, and their approximate weight. (The average ewe will weigh between 125 pounds and 150 pounds.) If one had 40 ewes weighing 140 pounds each, he would have 5,600 pounds of sheep. If each 100 pounds of sheep required 3.7 pounds of clover hay, his flock would require  $56 \times 3.7$  pounds, or 207.2 pounds of clover hay per day; and about one-half of this amount would be scattered in the feeding racks each morning, the balance in the evening.

If one will weigh a few forkfuls of hay occasionally, he can tell very closely, without weighing every time he feeds, about how much hay is fed each time.

If one is to feed a mixture of corn and oats, equal parts, he would simply mix together one or more hundred pounds of each; then, by weighing a few measurefuls of the mixture, he can tell approximately the right amount of grain to feed to his flock without weighing the grain each time he feeds.

**Questions:**

1. For what purposes do breeding ewes require food during the winter?

2. What are the results of over-feeding breeding ewes? Of under feeding?

3. How would you proceed to feed a flock of ewes, approximately the right amount of feed?

### **Arithmetic:**

1. How much will it cost to feed a 140 pound ewe 200 days, on ration No 1, if fodder corn is worth \$5.00 per ton?

2. How much will it cost to feed a 140 pound ewe 200 days, on ration No. 4, if clover hay is worth \$5.00 per ton, roots \$2.00 per ton, and corn and oats \$20.00 per ton?

3. How much will it cost to feed a 140 pound ewe 200 days, on ration No. 6, if straw is worth nothing, roots are worth \$2.00 per ton, and oats and bran are worth \$24.00 per ton?

### **SWINE.**

**Profitable Meat Production.**—Hogs are kept on nearly every farm, but only a small proportion of farmers raise enough hogs to make pork production an important factor in the income of the farm.

Pork production is, however, a very important enterprise on many farms, and has in many cases proved profitable; in fact more profitable than any other kind of meat production.

**Advantage of Hog Raising.**—Some of the advantages of pork production over the production of other kinds of meat are: First, a brood sow may produce from four to twenty pigs in a year. On this account the cost of a pig at birth is less in proportion than the cost of a calf or a lamb. Second, the fact that hogs have large litters, reach maturity quickly and do not require expensive shelter, enables one to get started in raising hogs more quickly and with less expense than is required to start with other kinds of live stock. Third, less labor is required to care for hogs than to care for enough cattle to bring in the same amount of money. Fourth, they consume and con-

vert into valuable products the wastes and slops of the farm.

**Disadvantages of Hog Raising.**—The main disadvantages of hog raising are: First, hogs are not able to use the coarse roughage, as corn stover and straw, that is usually found on the farm, hence cannot convert these products into salable form as can sheep and cattle. Second, their chief feed must be grain, at least for fattening, and grain feed is more expensive than roughage. Third, they are more likely to be taken off in large numbers by disease than are other classes of live stock.



Fig. 92.—Some good porkers of the bacon type.

**Possibilities.**—Hogs have probably been the means of paying off more mortgages than has any other class of stock. A young man wishing to make a start on the farm can well afford to give careful attention to hogs and their possibilities of producing a profit.

A good brood sow should have from six to ten pigs at a litter, and if desired may have two litters a year. Pigs, when eight months old, should weigh 200 pounds or more. If a sow produces 14 pigs in a year, and each pig when eight months old weighs 200 pounds, she would produce 2,800 pounds of pork in a year, which at 5c per pound would be worth \$140.00.

**Hog Cholera.**—The most dangerous disease of hogs is hog cholera, and it has caused the loss of millions of

dollars worth of hogs in the United States. Veterinarians have now discovered a method by which it is possible to vaccinate hogs and prevent their having cholera. They vaccinate in much the same manner as people are vaccinated to make them immune to small-pox. This vaccination is quite expensive and facilities for proper vaccination are not always available, so it is well to take every precaution to prevent the disease.

Hog cholera is a contagious disease. That is, hogs are very likely to take the disease if they come in contact with other hogs that are infected with it. The germs may be carried from one pen to another, or from one farm to another, on one's clothes, by dogs, by running water or by any other method by which particles of dust or disease germs might be carried about.

**Preventive Measures.**—If hogs are kept in clean, healthful quarters, given plenty of exercise, and fed, except when fattening, enough muscle-forming food, as clover pasture, clover hay, milk, shorts, etc., to keep them in good, vigorous condition, they will be better able to resist the disease than if they are kept in less thrifty condition. If cholera breaks out in the community, one should use every precaution to prevent the germs being brought onto the farm; and if it gets very close it is well to dispose of all the hogs that are fit to sell. If this cannot be done, often the loss may be greatly reduced by separating the hogs into several bunches and keeping them considerable distances apart.

### Questions:

1. What are some of the advantages of pork production over the production of other classes of meat? What are some of the disadvantages?
2. What can you say of the possibilities of pork production?
3. Tell all you can about hog cholera.

### Arithmetic:

1. What is the value of a hog weighing 225 pounds at  $5\frac{1}{2}c$  per pound?



2. A sow has 7 pigs in a litter. When 8 months old the pigs weigh 200 pounds each. What is the weight of all? How much are they worth at  $5\frac{1}{2}c$  per pound?

3. If a bushel of corn will produce 10 pounds of pork, how much will the feed for the production of a pound of pork cost, if corn is worth  $35c$  per bushel?

#### THE BROOD SOW.

**The Brood Sow** and her care and feed determine the cost of pigs at birth. In the first place a sow of good type, and of the breed desired, should be selected. If sev-

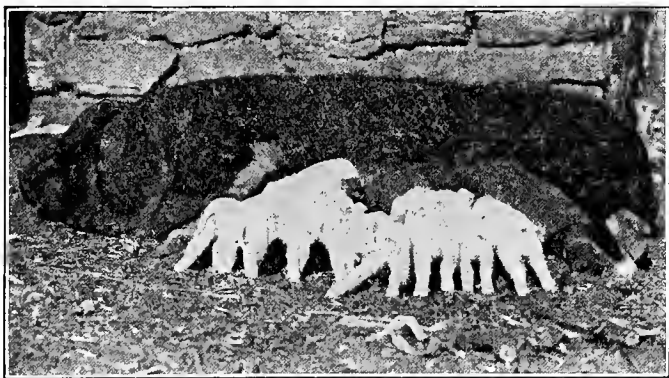


Fig. 93.—A Sow with Nine Pigs. One of the essentials of cheap pork production is a low cost of pigs at birth. Large litters reduce the cost per pig.

eral litters of pigs are raised, it is well to have some method of marking the young pigs, so that when they are grown one can tell from which litter they came. It is desirable to have brood sows that will have large litters of pigs; and if one selects his brood sows from a large litter he is more liable to get a good number of pigs from each sow than if he selects his sows from a bunch of hogs without regard to whether they came from large litters or not.

If one does not mark his pigs at birth, he is very liable

to select his young sows from small litters, because the sows with small litters feed their pigs a little better, and as a consequence the pigs are usually a little fatter and better looking than the pigs from large litters.

**Care of the Brood Sows.**—The brood sow should have plenty of succulent and muscle-forming feed, but should not be over-fed. She should have at all times plenty of exercise. It is a mistake to allow brood sows to run during the fall with the hogs that are being fattened. It is a waste of feed, and the sows are injured if allowed to get too fat. During the fall the brood sows should have the run of a good pasture, with only enough grain to keep them in good thrifty condition.

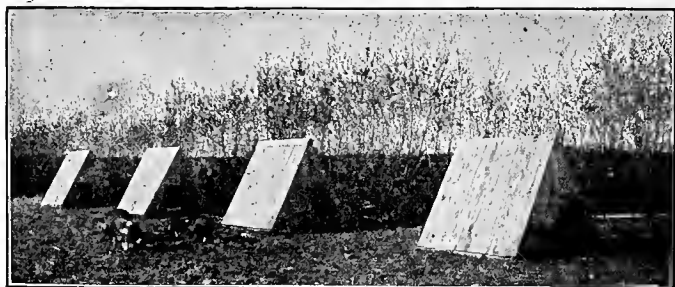


Fig. 94.—Hog cots. A very cheap and convenient shelter for hogs. These cots may be moved to the field during the pasturing season and back to the yard and banked up for winter.

**Shelter.**—If only one litter of pigs is to be raised from each sow each year, it is well to have them come as early in the spring as the weather is warm. If this is done, no expensive shelter is needed. A small cot (movable house) well banked, or a straw shed, is ample for the sow during the winter; and in summer all that is needed is shelter to keep the pigs dry and to protect them from the sun. If cots are used they may be moved to the pasture for summer shelter. Hogs need shade in summer.

If one is going to raise two litters of pigs from a brood sow in a year, good warm quarters must be provided. These quarters need not be expensive, but they

should be convenient and so constructed that the hogs may be kept comfortable.

**Feeding the Brood Sow.**—It is very easy to over-feed a brood sow in winter. If she has raised two litters of pigs during the year, so she is likely to be thin in the fall, she will need considerable feed until she begins to fatten up a little. If she has raised but one litter, which is the practice on most farms, she will have had the whole fall to fatten up, and very little grain is necessary or desirable during the winter.

**Bulky Feed.**—If only one or two sows are kept, the slops from the house furnish an excellent form of bulky feed, which helps to satisfy their appetites, but really contains little nutriment. If a large number of sows are kept, the slops from the house do not go very far, and one is liable to feed them more grain, to keep them from squealing, than they really need. If supplied with good clover hay, hogs will soon learn to eat considerable of it; and this furnishes the bulk they need and some nourishment, so they do not need so much grain to satisfy them. Roots are an excellent form of feed for brood sows.

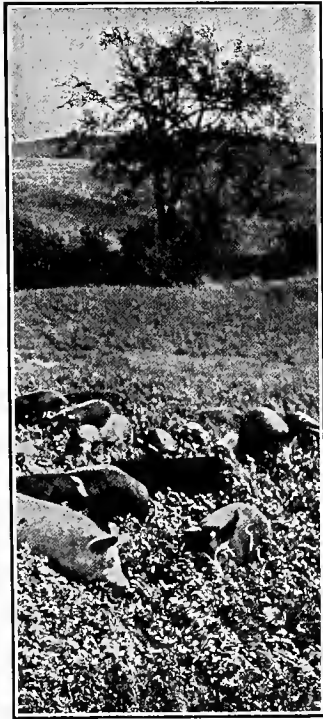


Fig. 95.—Pigs in clover. Clover is the cheapest and best summer feed for growing pigs. Pigs should have some grain and milk in addition to clover pasture.

As they are succulent, they aid in digestion, supply bulk and variety, and tone up the system.

**Suggested Rations.**—The following grain mixtures have been fed to brood sows, in addition to clover hay, with very satisfactory results:

1. Shorts 1 part, corn 3 parts (by weight).
2. Oil cake, 1 part, corn 7 parts (by weight).

About  $\frac{3}{4}$  pounds of either of these mixtures per day, per 100 lbs. live weight of hog, is sufficient if enough bulky food, as hay or roots, is fed to satisfy the appetite of the sow.

**Questions:**

1. What are some of the points worth considering in the selection of a brood sow?
2. What can you say concerning the care and shelter of brood sows?
3. Why is one liable to over-feed brood sows?
4. In what way may the tendency to over-feed brood sows be overcome?
5. How much grain does a brood sow need per day per 100 lbs. live weight?

**Arithmetic:**

1. If a sow weighs 350 lbs. and requires  $\frac{3}{4}$  lbs. of grain per day per 100 lbs. live weight, how much grain should she receive per day?

2. If it costs \$10 per year to keep a brood sow, what is the average cost per pig at birth, if she raises five pigs? If she raises eight pigs?

3. If 100 lbs. of shorts worth \$20 per ton and 300 lbs. of corn worth 42c. per bu. (56 lbs.) are mixed together, how many pounds of feed will there be in the mixture? What is the average price per pound? If a 400 lb. sow is fed  $\frac{3}{4}$  lb. of the mixture per 100 lbs. live weight, how much will her grain ration cost per day?

**CARE OF THE GROWING PIGS.**

**Requirements.**—The first requirement of young pigs is that they have a clean, dry, comfortable bed in which to arrive. As the mother is naturally in a feverish condition at this time, she may be somewhat careless and lay

on the little pigs. To prevent this, a shelf ten or twelve inches wide and eight or ten inches from the floor should be built around the pen, so as to make room for the pigs to get out of the way of their mother. This is a very simple precaution, and may save a number of pigs.

**Mother's Milk.**—The very best feed for young pigs for the first few weeks is the dam's milk. If the sow has been well cared for previous to farrowing and is liberally fed after farrowing, she will, if she is the right kind of a mother, give a liberal amount of milk. At two or three weeks of age the young pigs begin to develop a desire for something besides their mother's milk. Provision should be made to feed them some light but muscle-forming food, as skimmed milk with a little meal added.

**A Creep.**—To feed the small pigs so that the sow cannot bother them, it is well to have a small yard or pen fenced off in the yard or pen in which the sow is kept, but have the fence raised high enough from the ground so that the little pigs can pass back and forth easily, but low enough to keep out the old sow. In this place plenty of trough room should be provided, so every pig has a chance to eat, otherwise the larger, stronger pigs will get most of the feed and the smaller ones will not get enough.

**Clean Feed.**—Only clean, wholesome feed should be fed to the small pigs, and the trough in which they are fed should be kept clean; because their digestion is easily deranged and a pig is valuable only when his digestion is good. No feed should be left in the trough from one feeding time to the next. This is most easily accomplished by being careful to feed only as much as the pigs can eat up clean.

**Keep Pigs Growing.**—The aim in feeding young pigs should be to keep them growing every day; and since their capacity to make use of feed determines their usefulness it is well to so feed them as to strengthen and develop this capacity. Bulky feeds containing a good

proportion of muscle-forming feed, as milk, milk and shorts, clover pasture, etc., are very good kinds of feed for young pigs.

**Summer Feed.**—If but one litter of pigs is raised per year, which is the usual practice, they should come in the spring and can be raised on pasture. Pasture furnishes the cheapest feed on the farm, as well as one of the best kinds of feed. It has been the common practice to keep pigs in small pens and feed them grain and slops. This practice is undesirable for several reasons. It is an expensive method of keeping hogs, both in labor and in feed. It does not provide the exercise necessary for the best development of growing pigs or breeding stock. Last but not least, it is difficult to find any kind of feed so well adapted to the growing pig as good clover pasture, supplemented with milk from the sow, skimmed milk and good, clean slops thickened with shorts or other muscle-forming feed.

**Pasture.**—Red clover furnishes very cheap pasture, because the seed is sown with the preceding grain crop and no plowing or preparation of the land is necessary for the clover. Hogs like young and succulent pasture; and as clover grows very rapidly during the early part of the summer, and the young pigs do not eat as much as they will later, the clover, if the pasture is large enough, usually gets ahead of them. To avoid this difficulty it is well to cut with a mower a small strip of the clover next to the pens, early in June. This part will start up soon and furnish the best kind of pasture. The balance of the pasture may be cut for hay the latter part of June. Then the second crop will come on, and the hogs will be larger and need more feed than earlier, and will likely keep pace with the growing clover.

Rape, rye, field peas or any of the grain crops furnish good annual pasture for hogs, if for any reason one has not the clover. Blue grass and white clover, or bromus and white clover, make very good permanent pastures if it seems undesirable to rotate the crops and thus supply clover pasture.

**Fencing** is the most expensive part of furnishing pasture for hogs, but as a rule it is cheaper than the labor of caring for and carrying feed to the hogs would be. The cost of fencing may be reduced by having comparatively large, well-shaped fields, and by planning for them a rotation that will furnish the maximum amount of feed. A four year rotation, of 1st year grain, 2nd year clover, 3rd and 4th years corn, on four fenced fields of uniform size, is very satisfactory. One of the four fields would be in grain, one in clover and two in corn, each year; the clover and the two corn crops to be fed off by the hogs.

**Weaning Pigs.**—If but one litter of pigs is raised per year, they may be allowed to run with their mother until from twelve to sixteen weeks old, or even longer, until the sow begins to wean the pigs herself. If the young pigs are given a chance to learn to eat as suggested above, they may be weaned with very little difficulty at any time after they are six weeks old. If the sow is doing well, it is usually better to leave the pigs with her until they are about twelve weeks old.

### Questions:

1. How may young pigs be fed so they will not be bothered by their mother?
2. What is the best kind of summer feed for hogs, and how supplied?
3. In what way can the cost of fencing for hogs be reduced?

### Arithmetic:

1. If  $\frac{1}{2}$  acre of clover pasture is required for a sow and eight pigs, how many acres are required for six sows with litters?
2. How many acres of land in a field 20 rods by 24 rods in size? How many rods of fencing are required to enclose it? How many rods of fencing per acre? What would the fencing cost per acre at 50 cents per rod of fencing?
3. If it costs \$15.00 per acre to fence a field, what is

the annual cost of the fence if it lasts ten years and interest is charged at the rate of four per cent? (Ans.: 1-10 of \$15.00 and int. on \$15.00.)

#### FATTENING HOGS ECONOMICALLY.

**To Fatten Hogs** it is simply necessary to supply them with plenty of food, as they usually have a good appetite and are not easily injured by over-feeding. It is wise, however, to change them from one kind of feed to another gradually; that is, where they are being fed all they will take.



Fig. 96.—Hogs Helping Themselves to the Corn Crop.

The majority of hogs are fattened in the fall and early winter; and on that account we will suggest some of the better methods practiced in fall fattening.

**Labor.**—A very common practice followed in fattening hogs is to shut them up in a small yard and feed them generously. This practice, however, is no longer considered desirable, as the animals are not kept in the most rugged condition by being confined too closely; they



are more likely to become diseased, and a great deal of labor is necessary to feed and care for them when closely confined. Labor is one of the very important items in the cost of pork production, and every effort should be made to reduce the necessary labor to the minimum.

**Early Fall Feed.**—During the early part of the fattening season considerable green and succulent feed can be fed to advantage. This feed is very easily supplied by raising a patch of pumpkins near the hog pasture, where the pumpkins can be easily thrown over the fence to the hogs. Plenty of good pasture is also desirable at this time, and it may be supplied in any way most convenient.

**Field Peas.**—During the first part of the fattening period the pigs will make considerable growth; so some muscle-forming feed is desirable as a part of the ration, rather than an exclusive corn diet. A small field of field peas, so situated that they may be harvested by the hogs when ripe by turning the hogs into the field, furnishes the hogs an excellent start at very little expenditure of labor. The peas are sown very early in the spring, at the rate of 3 bu. of seed per acre, and nothing more is done to them until the hogs are turned in.

**Corn.**—After the peas have been fed off, or as soon as the corn is ripe if one has no peas, the hogs may be turned into a portion of the corn field and allowed to help themselves. If some green feed is provided by sowing rye or rape in the corn, at the time it was cultivated last, a large amount of green feed will be supplied at very small cost, and will be relished by the hogs in connection with the corn.

It costs only about half as much to grow a crop of corn up to the time it is ripe, as to raise, cut, husk and feed it. In other words it costs about \$5.00 per acre to cut, shock and husk one acre of corn, and by allowing the hogs to harvest the crop themselves this cost is saved. Of course the field must be fenced, but if regular fields are provided near the house, on which to raise pasture peas and corn for the hogs, and these fields are

permanently fenced, the annual cost of fencing is not a very large item.

Not all of the corn raised would be fed off, for it is not well to have the hogs in the field after snow and cold weather come. Six or eight pigs five to seven months old will ordinarily clean up an acre of average corn during the fall.

**Waste by Hogging Crops.**—Allowing hogs to help themselves to a crop is called “hogging off the crop.” It is generally considered that this practice is very wasteful—that the hogs trample down and waste a great deal of the crop. There is, however, very little of the crop wasted if the hogs are turned into a small patch (sufficient to last them two or three weeks) at a time.



Fig. 97.—Hogs in rape. Rape is one of the good pasture crops. The seed is cheap, and it may be sown six to eight weeks before the pasture is needed.

Results obtained by the Minnesota Experiment Station, and by a large number of practical farmers, show that an acre of corn will make fully as much and often more pork, where hogs are allowed to help themselves, than where the corn is husked and fed to the hogs in a yard.

At the Minnesota Experiment Station, one lot of hogs was turned into a field of corn, and another similar lot was shut in a yard and fed husked corn. It was found that the hogs in the field required 7.35 lbs. of grain to make a pound gain, while those in the yard required 8.59 lbs. of grain to make a pound of gain.

**Comfort.**—In fattening any kind of stock, comfort is an important factor, and one who overlooks it is a loser thereby. If hogs are fed in the field, a good soft and dry bed should be provided for them or they will not do their best, and they should always have a supply of fresh water. The same is true if they are kept in the yard. Some feeders claim, and with good reason too, that an armful of straw may often be as valuable to a bunch of hogs as a bushel of corn.

**Arrangement of Fields.**—Four fields adjoining the farmstead, each  $\frac{1}{2}$  acre to one acre in size, for each brood sow kept on the farm, make it possible to produce both summer and fall feed for hogs very cheaply. Each year one field would be sown to grain and red clover seed, and another field would be in pasture, and the other two in corn. Such rotation once established would supply an abundance of cheap feed and with the minimum amount of labor.

### Questions.

1. In what ways may we reduce the amount of labor necessary in caring for fattening hogs?
2. Of what use are field peas as a feed for hogs?
3. What can you say regarding "hogging off corn?"
4. What arrangement of fields tends to reduce the labor necessary to grow hogs?

### Arithmetic:

1. If it costs \$1.25 to plow an acre of land, 50 cents to harrow it 3 times, 25 cents to plant it, \$1.60 to cultivate it 4 times, and 60 cents to manure it, 25 cents for seed, and \$3.00 for rent, how much does it cost to raise an acre of corn?

2. If it costs \$7.50 to raise an acre of corn, and \$2.00 annually to fence it, how much does it cost per acre? How much does the corn cost per bu. if it yields 40 bu. per acre?

3. If it requires 8 pounds of ear corn to make one pound of pork, how many pounds of pork will 40 bushels of ear corn make? (72 lbs. per bu.) How much will the pork made from 40 bushels of corn be worth at 5 cents per lb.?

## CHAPTER X.

### POULTRY.

#### POULTRY ON THE FARM.

**Importance of Poultry Industry.**—Many people consider that raising poultry is a small business, hardly worthy of a man's time, and that a few chickens are good simply as a pastime for people who live in town, or as a source of pin money for women on farms.

It is true that the greater part of the poultry raised is raised in just this way, but in spite of this fact, poultry brings to the farms of the northwest many millions of dollars annually. In fact, the poultry product of the United States is greater than the dairy product. In many dairy

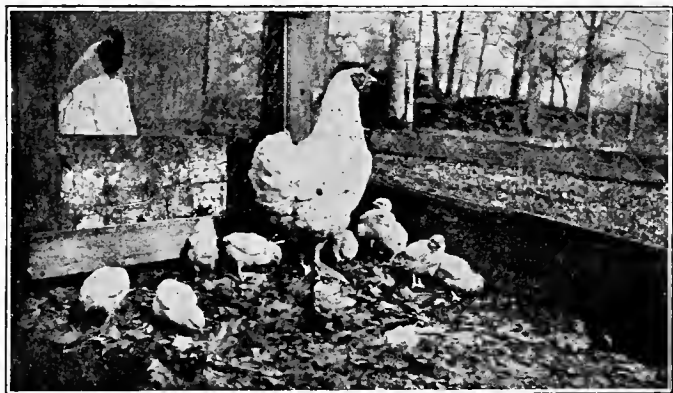


Fig. 98.—The whole family in the poultry yard.

communities, where creameries ship out twenty to fifty thousand dollars worth of butter a year, the poultry and eggs sold bring in as much, and in some cases more, than the butter.

**Poultry Records.**—The Minnesota Experiment Station has been gathering very accurate statistics for several

years, on eight average farms in each of three counties in Minnesota, namely, at Halstad, Norman Co.; Marshall, Lyon Co.; and Northfield, Rice Co. These statistics show that the value of poultry products, used and sold per farm in 1908, was \$56.61 at Halstad, \$95.75 at Marshall, and \$150.43 at Northfield. This makes an average of about \$100 per farm for poultry products per year.

**A Start with Poultry.**—Without hesitation we urge the boys and girls who feel a liking for poultry to undertake it as a means of earning a little spending money, of earning their way through school, or as a business worthy of studying and following as a vocation. As a beginning, relieve your mother of a part or all of the care of the poultry. She no doubt will share with you very liberally the earnings. If poultry is really a part of the farm business, and your father is at the head of it and making it pay, he will, or should at least, be glad to give you a definite part of the work to do and a share in the income, or preferably give you entire charge of a portion of the flock. If you have no poultry, but have a place where you can keep it, get a few specimens of the breed you like and start out for yourself. You will have many things to learn, but information gained in this way is fully as important as what you learn at school. Your father and mother will be able to assist you; and if there is a poultry man in the vicinity who is doing well, he will no doubt give you a great deal of valuable information. Then read a few poultry bulletins and papers as you get time, and you will gradually become interested as you find out how much there is to know about chickens and their care.

**Breeds of Poultry.**—There are a great many breeds of poultry, and most of them are good under special conditions. There is no best breed, and if you have not made up your mind which you prefer, get as good specimens as you can of the breed most common in the neighborhood.

All common breeds of chickens may be divided into three classes—egg, meat and general purpose—according to what they are adapted to produce, just as cattle are divided into dairy, beef and general purpose classes.

In the egg producing class we have the Leghorns, Minorcas, Spanish and Andalusians. In the meat producing class are found the Cochins, Brahmas, and Langshans. And in the general purpose class, or those well adapted to produce both eggs and meat, are the Plymouth Rocks, Wyandottes, Rhode Island Reds, and Orpingtons.

There are good and poor birds in any breed, and the only way to be reasonably sure of getting good chickens is to get them from a flock that has a good record as producers of either eggs or meat, or both.

**Questions:**

1. Compare the poultry and the dairy industries.
2. Does the poultry in your neighborhood receive as much attention as the dairy?
3. What is the conservative estimate of the poultry product of the State of Minnesota?
4. What are the three classes into which all the common breeds of poultry may be divided?

**Arithmetic:**

1. If a farmer keeps 50 hens and each hen lays 125 eggs in a year, how many dozen eggs will the farmer get in a year? How much will these eggs be worth at 20c. per doz.?
2. If a farmer keeps 50 hens and half of them produce 10 chickens each, how many young chickens will he have? How much are they worth at 35c. each?
3. If 9000 pounds of grain, worth 1c. per pound, is required to keep 50 hens one year and raise 250 chickens, what is the total cost of feed?

**CARE OF POULTRY.**

**Sitting Hens.**—Like any other class of live stock, poultry, to do well, must be well cared for. During the early part of the summer the young chicks require considerable attention. A great deal of time may be saved if several hens are set at one time in a building separate from the main poultry house. We mention raising chicks in this way because but comparatively few people use incubators. A woodshed or corn crib that is clean, and that may be

darkened, is a good place in which to set the hens. In the evening take as many broody hens as you can get, or as you want, and put them in this shed or crib, that has been well cleaned and provided with good, clean nests, preferably near or on the floor. Shut these hens in over night and darken the windows. If they continue broody the next morning, set them at once with eggs selected from the best hens. Then provide them with plenty of shelled corn or other grain, fresh water and a box of ashes or road dust for their dust baths. It will be well also to dust some insect powder in the nest to keep away lice and mites. It

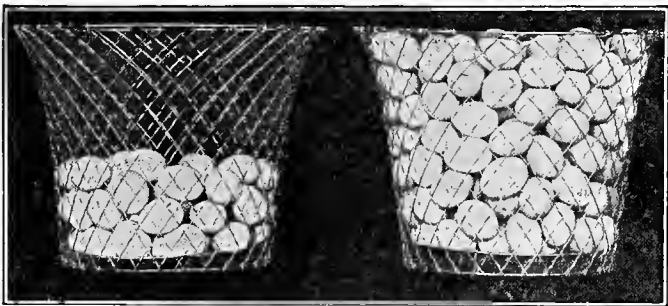


Fig. 99.—Two baskets of eggs. The one on the left represents the 75 eggs laid by the average hen in one year. The one on the right represents 220 eggs laid in a year by the best hen at the Crookston Experiment Station.

is but little more work to care for a dozen sitting hens in this way than to care for one.

**The Young Chicks.**—For the first day or so after the young chicks are hatched they will not need anything to eat, and it is well to keep them in the nest. If the room is darkened the old hens will not be in such a hurry to leave the nests. When the chicks are about 30 or 36 hours old, give them some bread crumbs slightly moistened in milk. Feed them several times during the day. After a day or so, some ground oats, with the hulls removed, may be added, and after a week or ten days some ground

or cracked grain, as corn or wheat, may supply a part of their ration. Very small kernels of wheat and millet seed are also very good. The chicks should be supplied at all times with pure, fresh water and fine grit. Too much care cannot be taken in keeping their water and feed clean. Plenty of exercise is also necessary. On the farm the chickens usually have the run of the whole place, which is the best possible condition for them, as they can then get exercise, insects, grit, and green food—things that are not so easily supplied when they are confined.

**Care of Hens in Winter.**—Eggs are one of the chief products of poultry, and one's success in the business usually depends upon getting eggs in the winter, when they bring a good price. To get eggs in the winter, one must supply as nearly as possible summer conditions. In other words, chickens must be forced to get exercise by scratching for their feed, as is necessary if their grain feed is thrown in loose straw or litter. They should have something to take the place of bugs and worms that they get in the summer. Scraps of meat and ground bone will answer. They must have something to take the place of the sharp stones and gravel that they pick up as they run about the fields. Crushed stone or crockery will supply this grit. Such material is sold on the market as grit, and poultry should always have a supply in winter. The grit aids them in digesting their food. They need something to take the place of the green food they get in summer. Cabbages, beets or potatoes will supply this need. Some material containing lime, from which they can make egg shells, is also necessary. Crushed oyster shells, kept constantly before them, will supply the necessary lime. They must be kept comfortable—that is, their house should be kept warm enough so they will not freeze their combs. Their houses should be sufficiently ventilated to supply fresh air and keep the coop dry. They should have a supply of pure water, a place for a dust bath, and a clean coop free from vermin. If these few simple precautions are observed and a liberal supply of a variety of grains, as wheat,



barley, oats, and corn, with an occasional mash, are supplied, poultry should prove profitable.

**Questions:**

1. In what way may the work of caring for sitting hens be lessened?
2. What can you say regarding the care of young chicks?
3. What conditions must be provided for hens in winter, if they are to lay?

**Arithmetic:**

1. The average hen lays about 75 eggs per year. What are the eggs worth at 20c. per doz.?
2. Some hens lay 200 eggs per year. What are the eggs worth at 20c. per doz.?
3. If a hen can cover 15 eggs, how many eggs will 7 hens cover? What would these hens cost at 50c. each?
4. If each hen lays 100 eggs, worth 20c. per doz., and raises 10 chicks, worth 30c. each, in a year, what is the annual income per hen? What is the total annual income from 50 hens?

**POULTRY HOUSE.**

**General Principles.**—If one is to make a success of raising poultry, he must provide suitable shelter. In fact shelter is one of the first essentials. Nearly every farm affords some sort of a poultry house, but many of these could be made better without any great additional cost. All farm boys and girls should know what constitutes a good poultry house, so they may know what modifications to make in remodeling the old house or building a new one.

There is no "best" type of poultry house, but all good poultry houses must conform to certain principles, and it is to discuss and make clear some of these principles that this article is written.

**Location.**—A poultry house should be located on well drained soil, with ample space for yards convenient to the house, and where some protection from the north

and west is afforded by a windbreak, building or hill. An orchard affords an excellent run for chickens. There they can get plenty of green food and insects, while in turn they prove a real benefit to the orchard.

**Size.**—It is not wise to keep more than fifty hens together, and where a greater number is kept, they should be in separate groups. Poultry houses are usually made 12 to 18 feet wide, and as long as needed or desired. If they are made too wide the sun cannot shine to the extreme back. If a house is 16 feet wide, and one wants to keep 50 birds, it would need to be about 16 feet long. From five to six feet of floor space should be allowed each fowl. If 100 birds are to be kept, the house should be built twice as long and divided into two parts. For



Fig. 100.—A poultry house 16x32, with 4 windows 2x4, giving 1 sq. ft. of window to 16 sq. ft. of floor space. Glass may be replaced with muslin as desired, or one window may be made longer and converted into a door.

200 birds the house should be four times as long and be divided into four pens.

**Light.**—Sunlight is the strongest known enemy of germs, and provision for plenty of light should be considered in remodeling the old house or in building a new one. Effort should be made to arrange the house and windows so that the sunlight can reach every portion of it during some part of the day. Windows also make the house warmer during the day. Some people, however, have gone to extremes and made nearly the whole south side of their poultry house of glass. This is liable to make the house too warm when the sun shines and too cold when it is dark. A general plan that seems to

meet requirements is to provide one square foot of window space to every 16 to 20 square feet of floor space.

**Ventilation.**—It is important to keep the air pure and dry in a poultry house, and this can be done only by providing some means of ventilation. This is easily accomplished in warm weather by leaving the windows open. The most approved method of ventilation in winter is by the means of muslin curtains in the windows. The window sash is opened and another frame covered with muslin is inserted in its place. In moderate weather a large opening is left, and as the weather grows more severe a smaller opening is left, but the windows should never be entirely closed. The muslin or duck curtain allows air to pass in and out freely, but prevents a draft.

**Warmth.**—Hens do not require a highly heated house, but they should not be exposed to such severe temperature as might freeze their combs. A house provided with a muslin or duck curtain at one or more of the windows on the south side is sufficiently warm during the day while the hens are exercising—scratching in the litter for their food—and at night their roosting place may be made warmer, if necessary, by dropping another muslin curtain in front of the roost. See Figure 102.

**Cleanliness.**—A successful poultry establishment must be kept clean, and every effort should be made, in building a poultry house, to make it easy to clean and to clean thoroughly. It is a good plan to make everything within the poultry house removable, so all can be easily taken out and a thorough cleansing and whitewashing given whenever desired.

#### **Questions:**

1. What improvements can you see might be made in your poultry house?
2. Give some of the considerations in locating a poultry house.
3. How large a house would you suggest for 50 hens?
4. What is the value of sunlight in a poultry house?

5. How may a roosting place be easily made warmer than the rest of the house?

6. What can one do to make it easy to keep a poultry house clean?

### Arithmetic:

1. How many square feet of floor space in a house 12 feet by 16 feet in size? If each hen requires 6 square feet of floor space, how many hens will such a poultry house shelter?

2. How many hens will a poultry house 16x32 feet accommodate, if each hen requires 6 square feet of floor space?

3. In a poultry house 6 feet wide and 16 feet long, how large a window should it have to supply 1 square foot of window to 16 square feet of floor space?

### ONE TYPE OF POULTRY HOUSE.

**A Poultry House.**—There are a great many types of poultry houses which include all of the principles required. It is simply a matter of choice with the owner. We describe a very common type, merely to emphasize the essentials mentioned in the previous section.

We will explain in detail a house 16x32 feet in size, large enough for from 80 to 100 hens.

It is placed on well drained land, somewhat protected from the north and west, and stands the long way east and west, with the high side to the south.

The foundation is of stone or concrete, set in the ground at least one foot, and extending above ground six inches. A sill 4x6 inches is placed on top of the foundation and the studding spiked on top of the sill. The house is 4½ feet high at the back and 8 feet high at the front. It has a shed roof made of boards covered with prepared roofing. The studdings are placed two feet apart and boarded with rough boards. The building is then papered with building paper and sided.

**Doors and Windows.**—A door is placed in each end, near the south side; and four windows, about 2x4 feet in size, are made in the south side. They are placed

high, so the sun will shine clear to the back part of the coop. There will be an opening near the floor on the south side, through which the hens may be let out, or a door may be placed in this side if desired. The windows are made to slip up and down, the same as in a house. At least one of the windows is provided with a muslin or duck curtain; and, except in the most severe weather, the upper sash is let down and the opening covered with the canvas. The canvas may be on a frame, hinged at the top, or simply tacked in the opening. This provides ample ventilation without draught and keeps the air pure and dry. In cold weather the windows may be partly closed, but never entirely.

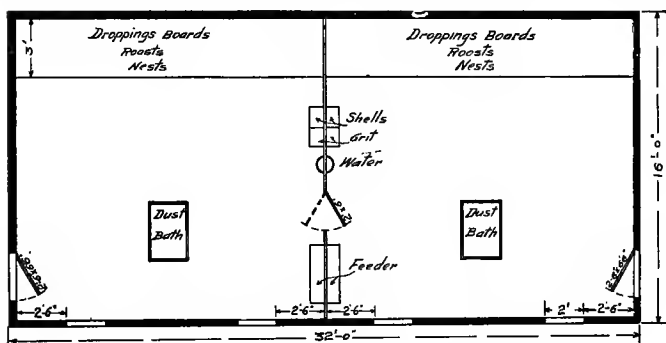


Fig. 101.—Floor Plan of Poultry House 16x32.

**Inside Finish.**—The inside may be left with the bare studding or preferably ceiled up with matched lumber. The house is partitioned into two parts, the lower three feet of the partition is made of boards, so the fowls cannot fight, and the upper part is of wire netting.

**Roosts.**—To make it easy to clean the coop, and to leave all the floor space available for feeding and exercising, a platform three feet wide is built against the north wall  $2\frac{1}{2}$  feet from the floor. This is to catch the droppings and should be made of matched lumber. Arms of 2x4s,  $2\frac{1}{2}$  feet long, are attached to the back wall

one foot above the platform, to extend out over the platform. Legs are placed under the outer ends of these arms to hold them level with the platform. On top of these arms and at right angles to them are placed two poles, or 2x3s edgewise, with corners rounded off, for roosts. The back roost is about one foot from the wall and the second fifteen or sixteen inches from the first. A muslin curtain is hung from the ceiling, to drop in front of the roosts when needed. To clean the droppings from the platform the roosts may be unhooked and removed, or the front side raised, and both hooked to the ceiling. They are then out of the way, so that the cleaning may be thoroughly done.

**Nests.**—For nests a box 8 to 12 feet long and 12 inches wide is made, with sides 8 inches high. This is divided

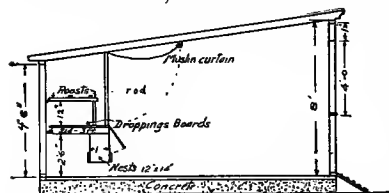


Fig. 102.—Cross section of poultry house; note arrangement of roosts and nests which leaves all floor space open.

into nests 12 to 14 inches long, with partitions 18 inches high. Hens prefer nests that are rather dark, so a good place for them is under the front edge of the platform. Place this row of nests close up under the front edge

of the platform used for dropping board. Then hinge a 10-inch board in front of the nests to close the 10-inch space between the platform and the 8-inch board on the front side of the nests. This darkens them somewhat. The hens enter from behind. The high partitions between the nests prevent the hens from going from one nest to the next, so they are not likely to disturb one another and break or dirty eggs. When gathering the eggs the board in front is opened. These nests should be loose, so they may be taken out to be aired, sunned and sprayed, when desired, to keep them free from mites and lice.

**The Floor.**—A cement floor covered with a little sand and clean litter is the best for a poultry house, as it can be kept dry and clean with very little work.

With a poultry house as described, one can keep poultry clean and comfortable the whole year through.

**Questions:**

1. What can you say regarding the size and arrangement of windows in a poultry house?
2. What advantage is there in having the roosts and other inside fixtures of a poultry house removable?
3. Describe a good arrangement for nests in a poultry house.

**Arithmetic:**

1. How many yards of muslin in a strip 16 feet long and 3 feet wide? How much would it cost at 12c. per yard?
2. How many feet of lumber would be required to build a platform 3 feet wide by 16 feet long? (Allow 1-6 for matched lumber.) How much would it cost at \$30.00 per thousand feet?
3. To make a row of nests 12 ft. long, as described above, requires 2 pieces 1x8, 1 piece 1x10, and 1 piece 1x12—all 12 ft. long, and 1 piece 1x12, 20 ft. long. How many feet of lumber are required? How much would it cost at \$24.00 per thousand feet?

**EGGS.**

**Uses of Eggs.**—There is perhaps no article of food more commonly and generally used than eggs. It is estimated that they form 3 per cent of the total food of man. They are boiled, fried, poached, scrambled, and sometimes baked, to form a substitute for meat. Raw eggs are used in many different drinks. They are essential in cooking. Omelets, custards, cakes, and many icings, all require eggs. In foods where eggs are combined with other materials, the purpose of the egg is to give consistency, flavor, color or lightness, as well as to contribute to the nutritive value of the compound. Thus, in the custard, eggs thicken. In cakes, especially in the sponge cake, we have an example of eggs used to leaven or give lightness. The well-beaten white incloses air

in small bubbles. It is the presence of air that causes the white to assume so different an appearance as the beating process continues. When this beaten white is mixed with other materials and baked, the whole composition remains light and porous, because the heat has made the walls of the air cells firm and their shape is maintained.

**Food Value of Eggs.**—Milk and eggs have sometimes been termed “perfect foods,” in as much as each contains all the elements needed for the growth and development of young. But they are not perfect foods in the sense of being all-sustaining to adults. Eggs are rich in protein, the substance needed to build up and repair the tissues of the body. They also contain considerable fat. But the third element of food, carbohydrates, must be supplied by the use of bread, sugar or vegetables to form a complete diet. The following table will show how eggs compare with a few of the animal products:

	% Protein.	% Fat.	% Carbohydrates.
Eggs .....	13.4	10.5	
Sirloin Steak ....	18.9	18.5	
Oysters .....	6.2	1.2	3.7
Milk .....	3.3	4.0	5.0
Cheese .....	25.0	33.0	2.4

As shown by the table, eggs are very nutritious food and rank well with the meats. The amount and kinds of nutrients indicate that they may safely be used in the diet in the same way as most animal foods.

**Cooking Eggs.**—Numerous experiments have been made to show the effect of heat upon egg yolk and the egg white or albumen. It has been found that if an egg is put into boiling water (212 degrees F.) and kept there any considerable time, the albumen becomes hard and tough, also undergoes shrinkage. The same amount of heat produces a like result upon the egg when it is removed from the shell and mixed with other materials,



though the effect is not so noticeable. This fact explains the curdling of custards, shrinkage and toughening of omelets and sponge cake, when the proper amount of heat has not been employed in the cooking. The yolk of the egg cooks at a lower temperature than the white. If an egg is cooked in water about 160 degrees F., the albumen will become white and firm, but remains tender and is more easily digested, while the yolk will also cook thoroughly.

**Boiled Eggs.**—Among the more common ways of serving eggs, the soft boiled and the hard boiled are most generally recommended. As the cooking is influenced in so many different ways it is extremely hard to give definite directions. The amount of water used, the kettle employed, the temperature and freshness of the eggs, as well as the number to be cooked, all have an influence and must be taken into consideration. Only general directions and the theory of the process can be given. The desired results can soon be obtained by each housekeeper after a few trials. By using the same kettle, observing the same conditions as to temperature and amount of water, a housewife, with usually the same number of eggs to cook each meal, may soon feel as certain of the condition of her boiled eggs as she is of her bread.

**Soft Boiled Eggs.**—The term “boiled eggs” refers to eggs cooked in their shells in hot water, though not necessarily boiled. The following is a general direction to secure soft boiled eggs: Put over the fire in a kettle that may be closely covered (a granite kettle is preferable, as it holds heat better) about two quarts of water. When the water is boiling, raise the kettle from the stove, and as soon as the bubbling ceases, slip the eggs into the kettle, cover immediately and place in the warming oven, on the reservoir, or any place where it will not gain more heat nor readily lose what it has. The two quarts of water should be sufficient to cook about six eggs. Let the eggs remain eight minutes and then

immerse in cold water. At the end of that time the eggs should be soft boiled, i. e., the white should be firm but tender, and the yolk thoroughly cooked, though still in liquid form. Such soft boiled eggs are very different from those put into boiling water and actually boiled three or four minutes. In the former the white is noticeably more tender and uniformly cooked, and the yolk is more thoroughly cooked because of the longer time of cooking. For hard boiled, the eggs are treated in the same manner, only left for 20 or 30 minutes.

When the eggs are put in, the water is practically at 212 degrees F. or boiling point, but the presence of the eggs immediately lowers the temperature of the water to about 160 degrees F., which is the desired temperature to cook the albumen and is also sufficient for the yolk. This process seems simpler and more practical than to employ a thermometer and ascertain the exact temperature.

### Questions:

1. Give some of the ways in which eggs are used.
2. Explain how beating egg white makes it light and foamy.
3. What two nutrients are found in eggs? What nutrient is not found?
4. What effect does boiling have on albumen?
5. State a simple process to secure soft boiled eggs without toughening the albumen.

### Arithmetic:

1. If a dozen eggs weigh 22 ounces, and contain 13.4% protein and 10.5% fat, how many ounces of protein and of fat do they contain?
2. If a sirloin steak contains 18.9% protein and 18.5% fat, how many ounces of protein and of fat in 1 pound?
3. If one eats 3 eggs weighing 2 ounces each, how much protein and fat does he get if eggs contain 13.4% protein and 10.5% fat?

## CARE OF HENS IN WINTER.

**Eggs in Winter.**—One of the great problems of the poultryman is to get eggs during the winter, when they are sure to bring a good price. Only the careful and thoughtful are able to get eggs in any quantity during December, January and February. Those who do make a careful study of feeding and care can be sure of good results on the average, but even when apparently all conditions are favorable, unavoidable conditions occur which make results uncertain.

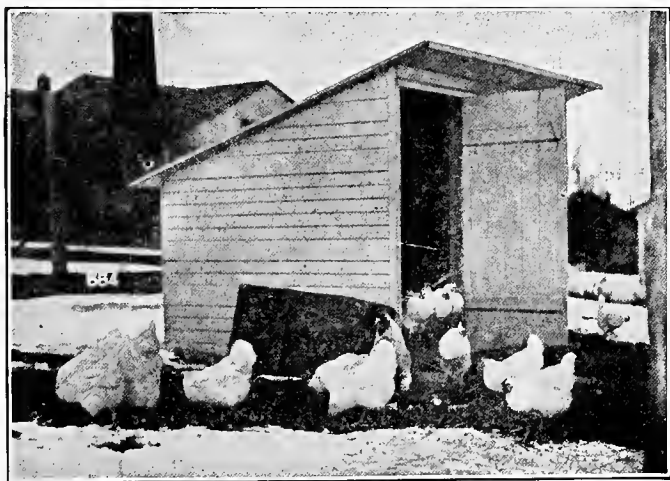


Fig. 103.—Hens in Colony House.

**No Rule To Follow.**—There are no set rules to follow in successful poultry feeding, as there are many conditions which influence the amount and kind of feeds needed by a flock. A flock of Plymouth Rock hens will need more to eat than the same number of Leghorns, because they are larger. In severely cold weather the same number of birds will need more food than they will in

warmer weather. A flock of pullets may be fed slightly more without danger of getting them too fat, than can a flock of mature hens. Hens getting a great deal of exercise will require more food than those getting little or no exercise.

**Hens Too Fat.**—One very general cause of low egg yields is that the hens are too fat. Hens ranging over the fields, about corn cribs and granaries and in feed yards during the fall and early winter become very fat, and fat hens never lay well. Young pullets that are growing during this period are less likely to become too fat than are old hens, and for this reason pullets are more likely to lay well during the early winter than are older hens. For these reasons it seems best on the average farm to keep over mostly pullets for the winter layers.

**Exercise.**—Hens, like people, if they get their wants supplied too easily will not take the exercise they need. Plenty of exercise and care in feeding will do much to prevent hens becoming too fat. In the winter, exercise is most easily induced by so feeding hens that they are required to make considerable effort to get enough to eat. The floor of the pen or house in which the hens are kept, or an adjoining shed, should be so arranged that the floor may be kept covered with straw or litter into which the grain feed of the ration may be scattered. The hens will then have to scratch a considerable portion of the day to get the grain, and will get much needed exercise in this way. A beet or a cabbage hung on a string, just high enough from the floor so a hen will have to jump a little to reach it, will encourage them to exercise.

**Lice and Mites.**—A very frequent cause for poor egg yields is lice or mites, or both, which make the hens so uncomfortable that they cannot lay. These vermin are always present, and only by constant care and attention can they be controlled. Cleanliness is the first step in fighting these parasites. All litter and droppings should be cleaned out frequently and fresh litter put in. White-washing the interior of the hen house once or twice a

year is also helpful. A good-sized box filled with road dust should always be provided for hens that are confined.

Occasionally spraying the roosts and the inside of the house with kerosene emulsion, and painting the roosts with liquid lice killer, are very good methods of destroying these pests, especially if repeated in a few days. Air-slaked lime, fine dust or ashes should be applied to the dropping boards after each cleaning.

**Small Things.**—While the poultry business amounts to millions of dollars each year, the production of poultry products on any farm is simply attending to a lot of little things. One who is not observing of little things and willing to keep constantly after details will probably not succeed in the poultry business. One who is willing to look after the little details that will make his poultry comfortable is quite certain of good results.

### Questions:

1. Give several conditions which influence the amount of feed required by a flock of laying hens.
2. What is one of the general reasons of low egg yields in winter?
3. In what way is it practicable to enforce hens to exercise?
4. Enumerate the details that must be looked after in caring for a flock of hens.

### Arithmetic:

1. If 9 eggs are obtained daily from a flock of 36 hens, what proportion of the hens is laying?
2. If a flock of 36 hens lay 9 eggs per day, how many dozen will be produced in a week? In a month?
3. If eggs are worth 35c. per dozen, how much are 9 eggs worth? How much are  $5\frac{1}{4}$  doz. worth? How much are  $22\frac{1}{2}$  doz. worth?

## FEEDING LAYING HENS.

**Rations for Laying Hens.**—It is not easy to determine the amount of feed eaten by an average laying hen. If one is to study the poultry business from a practical point of view he must know approximately the requirements of his flock. As stated in the last lesson, food requirements vary; but it is well to have some basis on which to base one's calculations. We submit below a few rations that have been fed by practical poultrymen, successfully. The following rations are based on the requirements of an average laying hen for one day.

**Ration No. 1**, reported by The Cornell Experiment Station. Sec Bulletin No. 212, page 11: .175 lbs. wheat; .07 lbs. ground bone; .022 lbs. cabbage.

The above is the average amount fed per day to each hen. The actual amount varied each day as the requirements of the hens varied. Early in the morning a part of the wheat was scattered in the straw on the floor of the coop. In the middle of the afternoon the flock was fed all of the cooked cut meat and bone they would eat up quickly. Then at 4:30 p. m. they were given a liberal feed of wheat again. The wheat was always scattered in the straw to make the fowls exercise. The cabbage was fed by having one suspended from a wire and in reach of the hens.

In addition to the feed, the hens always had a supply of fresh water, grit and oyster shells. Grit is necessary to aid in the digestion of the food, and oyster shells are necessary to supply the material of which egg shells are made.

**Ration No. 2**, reported by the Utah Experiment Station, Bulletin No. 92, page 139: .156 lbs. mixed grain; .022 lbs. ground bone; .004 lbs. beef scraps; .008 lbs. gluten meal; .066 lbs. skimmed milk.

As in ration No. 1, grit, shells and water were supplied in addition to the feed. The figures represented the average amount of each kind of feed given per day

to each hen. Ration No. 2 supplies a little more variety than ration No. 1, but has the disadvantage of necessitating the purchase of feeds other than those raised on the farm.

**Variety.**—Hens, like any other class of stock, like a variety of foods, and in this respect the last ration is good. Variety in grains is very desirable, and is easily provided by feeding a mixture of the common farm grains. Corn can profitably be added to the ration, even of laying hens, to replace a part of the grain feed. Corn is the cheapest of the grain feeds. If corn is fed, it is well to give it the last thing in the afternoon, so the hens may have a crop full to go to roost on. It is not well to feed too large an amount of corn, as it is too fattening. Millet seed, buckwheat and sunflower seed are good feeds to add in small amounts to the grain ration, to add variety.

**Green Feed.**—Chickens will eat quite an amount of fine cut clover or alfalfa, or the leaves that may usually be gathered in the mow or at the bottom of the chute where clover or alfalfa hay is thrown down. This may be fed dry, or moistened and mixed with a little ground feed. Hens will eat several pounds of this material during the winter, if given the opportunity.

Mangels, beets or carrots are also valuable feeds for laying hens in winter. Such feeds take the place of the green grass hens take in the summer.

**Ration No. 3.**—Fed with good results by the Maine Experiment Station. See Farmer's Bulletin No. 357, page 33, U. S. Dept. of Agriculture: .246 lbs. grain and meal; .011 lbs. oyster shell; .006 lbs. dry cracked bone; .005 lbs. grit; .006 lbs. charcoal; .027 lbs. clover.

The above is the average amount given per hen per day. This ration was fed in practically the same manner as ration No. 1, except for the mash or ground feed. This mash was made of a mixture of 2 parts by weight of bran, 1 part corn meal, 1 part middlings, 1 part gluten meal, 1 part linseed meal and 1 part beef scraps, and

was kept constantly before the birds in a feed trough with a slatted front. This mash was fed dry.

A simpler mash, composed of bran, some ground grain of any or several kinds, and if possible a little beef scrap, would likely give as good results as the more complicated mash.

### Questions:

1. Describe the method followed in feeding ration No. 1.
2. What can you say regarding feeding hens several different kinds of feed?
3. In what ways may green feed be supplied to hens in winter?
4. Describe the composition and method of feeding the mash in ration No. 3.

### Arithmetic:

1. How much of the various kinds of feed will a hen eat in 200 days, if fed ration No. 1?
2. How much will it cost to feed a hen 200 days on ration No. 1, if wheat is worth 80c. per bu., ground bone 1c. per lb., and cabbage \$5.00 per ton?
3. How many eggs must a hen lay in 200 days to pay for her feed, if she is fed ration No. 1 and eggs are worth 25c. per dozen?



## CHAPTER XI.

### THE FARM HOME.

#### WHAT A DESIRABLE HOME SHOULD BE.

**Pleasant Surroundings.**—Almost every one prefers order, neatness and beauty in preference to their opposites—disorder, untidiness and bareness or lack of beauty. A farm seems more valuable if the yards surrounding the house and barn are clean, neat and orderly. If one sees a smooth, well kept lawn, with a few appropriate shade trees and flowers, he feels sure that here is prosperity, or here, at least, is a restful home.

In cities and villages considerable attention is paid to beautifying the lawns, and a very little effort in this direction adds an elegance and charm to an otherwise plain home.

**Facilities.**—The farm folk may not have much time to think how they would enjoy these things, or to establish and keep such conditions, but there are many things that can be had with but little effort and little expense, and there are many things which the boys and girls can do. In the country, where there is plenty of room for a lawn, for flowers, ornamental shrubs and trees, and where good soil, fertilizer, team and machinery for fixing up a lawn are available, it is to be regretted that these possibilities are so little realized.

**Neatness.**—The first step for the boys and girls, who are anxious to aid in beautifying their homes, is to keep things as neat as possible. No boy of school age but can move a pile of ashes if the ashes during the winter have been piled too near the house. Raking the chip yard is not too difficult for the average boy. Often broken dishes, tin cans, old shoes, etc., have been cast into a pile somewhere. These are best removed and buried. Frequently the banking is left until late into the summer, or only partly removed because of frost when the work was begun. A little persuasion from the

boys or girls might bring the team and wagon to the house at the close of a day's work, to remove the banking or the remaining portion of it.

**The Lawns.**—When neatness has been established, consider next the lawn. Many farmers have reasonably smooth lawns covered with good sod. If this is well burned over and thoroughly raked in the spring, it will not be difficult to keep it cut with a lawn mower all summer. One must not let the grass get the start of him or it will be difficult or perhaps impossible to cut it with a mower. A lawn mower may sound like an extravagant article, but it is not expensive considering the number of years one may be run.



Fig. 104. View of a Pleasant Farm Home, Showing Good Effects of Lawn, Vines and Trees.

Many farm yards are bare and packed hard from frequent travel. In such cases the aid of the father or "big brother" must be solicited to plow it up and perhaps grade it a little. If the soil is not rich enough, a few loads of manure and black earth might have to be hauled. The boys and girls can finish the work by thoroughly raking the soil to prepare it for the seed. Blue grass alone is the most desirable lawn grass, but as this starts very slowly it is well to mix with it some

more rapid growing varieties, such as white clover and red top. Sow this mixture very thickly, and rake again to cover the seed. If convenient, roll the lawn to make a smooth surface and give the seeds a better chance to start quickly.

The lawn should be plowed and seeded as early in the spring as convenient, as it then has the spring rains to start the grass. The farm lawns may suffer during a dry summer, but under ordinary summer conditions they will thrive and do well if the soil is kept rich by an occasional dressing of well rotted manure.

Where it is necessary or desirable, paths may be made of gravel or sand.

A few good shade trees and ornamental shrubs add much to the appearance of a farm yard, and there is no reason why Arbor Day cannot be observed on the farms and many desirable trees set out. Soft maple makes a very beautiful shade tree and is of reasonably quick growth. The elm is a popular tree for the yard or drive way. The box elder is commonly used and makes very rapid growth.

### Questions:

1. Give as many reasons as you can why a neat, orderly farm home is preferable.
2. What is the first step in improving the appearance of a farm home?
3. Tell what you can about starting a lawn.
4. Write what you can about shade trees.

### Arithmetic:

1. How many cubic yards of black dirt are required to cover a lawn 100 ft. square 1 in. thick?
2. If it takes an hour to mow a lawn, 100 ft. square, and it must be mowed 18 times during the summer, how many hours of time are required? How much is this time worth at 15c. per hour?
3. How far would one have to walk to mow a lawn 100 feet square, with a lawn mower that cuts a swath 16 inches wide?

## WIND BREAKS.

**Value.**—A good wind break about a farm home is very valuable and is one of the luxuries that may be had at very little expense. If there is a good wind break about the buildings, less fuel is required to keep the house warm and the stable will be much warmer. Animals must be kept warm during the winter, either by shelter or by feed. If they are exposed to the cold winds or are kept in cold stables they must have more feed. Feed is too expensive to be given merely to produce warmth. The shelter belt really saves feed, which is worth money.

The wind break also protects the orchard and garden from early frost, from storms, and from hot winds, making them much more likely to produce good crops.

It is a great comfort to hay makers and harvesters to get behind a good wind break, on windy days, to unload hay or grain. Many times it is possible to finish stacking behind such shelter, when it would be impossible to handle the hay or grain out in the open.

The wind break makes the task of doing chores much pleasanter and easier during the winter than it would be if the buildings and yards were exposed.

**Kinds of Trees to Use.**—There are many kinds of trees that make good wind breaks. The first requirement is that they are hardy—that is, will not kill out during the winter or during a dry summer. Second, that they have a neat appearance and grow in such form that they really check the wind.

In starting a new wind-break, trees that grow rapidly are, as a rule, used. The white and the golden willow, cottonwood, Norway poplar, box elder, soft maple, etc., are some of the rapid-growing trees. These trees, if properly set out and cared for, will make a good wind break in five to ten years. Trees that grow rapidly usually do not last very long, so if the quick-growing trees are used, slow-growing and longer-lived trees should be set among them to replace them when they begin to

die and break down. Some of the common slow growing, long lived trees are the elm, hard maple, green ash, and several of the evergreens.

**Planning for the Wind Break.**—In planning for a wind break it is well to make a sketch of the farm, showing the buildings, lanes, fields, drives, yards, etc., and so arrange the trees in setting them out as to give protection from the north and the west winds. If possible arrange the trees so that the road and other points of interest may be seen from the house.



Fig. 105. An Evergreen Wind Break.

The wind break should be far enough from the buildings, so snow will not drift about them or into the yards. It is well to have the wind break include the garden and orchard as well as the buildings.

**Questions:**

1. Of what financial value is a wind break?
2. What kinds of trees are suited to use as wind breaks?

3. For what reasons would you have the shelter belt or wind break a considerable distance from the buildings?

**Arithmetic:**

1. What is the cost of 1500 willow cuttings at 75c. per thousand?

2. What is the cost of 460 spruce seedlings at \$5.00 per hundred?

3. How many trees will be required to set three rows 20 rods long—trees 4 feet apart in the row?

4. How many willow cuttings will be required to set 3 rows 60 rods long, cuttings 2 feet apart in the row?

**SANITATION.**

**Healthfulness of the Home.**—The first thing to be considered about a home is its healthfulness. No matter how beautiful, attractive and comfortable a house may be, if it is not a healthful place in which to live, no one who may exercise a choice would desire to live in it. One who is building a new house may select a site which will give drainage, ventilation and plenty of sunshine. One who is buying a farm, expecting to live in the house already upon it, would do well to consider the healthfulness of the situation as well as the fertility of the soil. Many who find themselves in unhealthy homes which are theirs by inheritance, or which for some reason they saw fit to acquire, may often, with but little labor and expense, make the place quite as healthful as any they might have selected.

**Drainage About the Home.**—The healthfulness of a farm home depends first of all upon drainage. There should be a good slope away from the house, so that the cellar and grounds around the house may be dry. The well should be so situated that no surface water, or seepage from house, barn or any other building, can possibly get into it to contaminate the water during any season of the year. It is of the greatest importance to the health of all in the home that the drinking water

be kept pure. If one finds that he is living in a house where water stands in the cellar and the yard is wet and muddy, he may be sure that sanitary conditions there are not what they should be. A system of drainage such as would give the desired result should be carefully planned and put in. An open ditch could be made to serve the purpose, but a tile drain is preferable. If it is worth while to drain land that it may produce better crops, surely it is worth while to drain, when necessary, to make the home surroundings more healthful.

**Chickens**, turkeys or fowls of any kind should not be allowed about the well or in the yard immediately surrounding the house. They are not only one more means of carrying dirt to the house, but they also destroy grass. If a good lawn can be maintained about the house, it helps materially in preventing dust from blowing into the house.

**House flies** are a great menace to health as well as to comfort. If there is disease in any home in the neighborhood, flies may carry the germs on their legs and bodies and so infest other homes. It is generally believed that they breed to a great extent in horse manure. For this reason, if for no other, manure should not be allowed to accumulate in the yards or about the barn.

Houses should be well screened against flies. Removable wire screens are the most desirable. While they may be a little expensive at first, they last so long that their yearly cost is very slight. If they are taken down in the fall and carefully put away for the winter, and then given a coat of thin paint before they are put up in the spring, they will last almost indefinitely. Where such screens cannot be had, mosquito netting may be used.

**Bacteria.**—Even when the outside conditions are all that they should be, a crusade against dust and germs must be kept up within. A few years ago germs and microbes were practically unheard of. To-day we hear and read much about them, and are just beginning to realize their influence. There are a number of terms in

common use to-day which it may be well to understand. We often hear or read about bacteria. They are very simple, minute organisms belonging to the vegetable kingdom. They live in soil and water and on the skin of man and beasts. There are hundreds of species of them. Some species are helpful—such as cause decay of vegetable matter in the soil and so enrich the soil—other species produce disease. Protozoa is another term



Fig. 106.—A farm home so situated as to afford good drainage. Shade trees are an excellent addition to a home, but should not be so close or so thick as to prevent a good circulation of air and the entrance of sunshine to the rooms.

we often hear. It is applied to the simple, minute organisms belonging to the animal kingdom. These organisms, so small that they can be seen only with a microscope, whether animal or vegetable, are called germs, microbes and micro-organisms.

It is now known that these germs or microbes cause many of our contagious diseases, such as tuberculosis (consumption), diphtheria, and typhoid fever. The mis-



truss of a household must remember that she cleans her house, not only that it may look well-kept, but more especially to make it sanitary. While dust and dirt in themselves may not be directly harmful, they are likely to become hotbeds for disease germs.

**Questions:**

1. What may often be done to improve unsanitary conditions if they exist?
2. Why should not fowls be allowed about the house?
3. What are the objections to house flies, and how may they be kept out?
4. Explain the terms bacteria, protozoa, and germs or microbes.

**Arithmetic:**

1. How many sq. ft. of wire netting are required to make a screen for a window 30 in. by 60 in.? What would the screen cost at 2c. per sq. ft.?
2. What is the cost of screen at 2c. per sq. ft. for a door 3 ft. by 7 ft.?
3. Screen window frames are usually made out of lumber 1 in. thick and  $2\frac{1}{2}$  in. wide. How much lumber is required to make a full size screen frame for a window 30 in. by 60 in.? What is the lumber worth at \$35.00 per thousand feet?
4. Screen door frames are usually made of lumber  $1\frac{1}{4}$  in. thick and 3 in. wide. How much lumber is required to make a screen door frame 3 ft. by 7 ft.? What is the cost of the lumber at \$35.00 per thousand feet?
5. What is the cost of material to make screens for a house having 3 doors and 14 windows? (Use sizes and prices given above.)

**SANITATION APPLIED TO HOUSEHOLD DUTIES.**

**Health on the Farm.**—When people become sick, they often go to a sanitarium or a hospital, where they pay from ten to fifty dollars a week for treatment, consisting of pure air, sunlight and wholesome food. All of these are free and abundant on the farm, if reasonable precautions are taken and a few simple rules of sanita-

tion and health observed, some of which are here suggested.

**Sweeping.**—In sweeping, the object is to remove dust and dirt. Therefore care should be taken to keep the dust down. If a carpet is to be swept, it should first be sprinkled with tea leaves, moist bits of paper or something similar. If smooth, uncarpeted floors are to be swept, they may first be sprinkled with moist sawdust. Sawdust and dirt are then easily removed with a soft, brush-like broom, without raising the dust. Such floors may also be swept with a broom slipped into a soft woolen bag. It is well to moisten the bag with kerosene. Rugs and draperies should be shaken out of doors. These methods not only insure clean houses, but they also protect the worker. To breathe dust during sweeping period, day after day, is unpleasant and quite likely to cause catarrh or throat or lung trouble.

**Dusting.**—In dusting, the same object holds true as in sweeping—namely, to actually remove the dust and not to merely dislodge it from conspicuous places. The woodwork and furniture of a room should be carefully wiped off with a soft, loosely-woven cloth, and the cloth shaken out of doors frequently. Some people prefer the cloth moistened with kerosene or furniture oil.

**Washing Dishes.**—In washing dishes, use plenty of hot water and change the water often. Soap, borax or any preparation that will soften the water and remove grease, may be used in the wash water. Scald the dishes with an abundance of boiling water, and dry them with a clean towel. Too much emphasis cannot be put on the importance of clean dish cloths and dish towels. As dust and germs are constantly flying in the air, the dishes between meals should be kept in a tight cupboard if possible.

**Washing Clothes.**—Perhaps it is quite generally thought that clothes are washed merely to remove the dirt and so restore them to their normal appearance. There is a much deeper reason for the old established wash-day than that. The skin helps to regulate body

heat. When the temperature becomes too high, the body is cooled off by the evaporation of perspiration.

The skin also helps to throw off some of the body's waste products in the form of secretions. The perspiration and secretions are absorbed by the clothing, especially by the under garments. Bits of skin are constantly being worn off, and they also find their way into the meshes of the clothing. After the garments have been worn some time, their pores become filled and the garments lose their absorptive power. In such condition they cannot assist the skin in removing these secretions of the body, but instead are a hindrance. A thorough washing removes the dirt and opens the pores of the clothes, and the drying restores their power of absorption. Then, too, where waste products accumulate in clothing bacteria are apt to be present. Washing is necessary to remove bacteria, and all garments that can be boiled without injury should be boiled for at least twenty minutes each time they are washed, to kill bacteria. Hanging clothes in the air and sunshine helps to accomplish the same object.

### Questions:

1. What is it that may be had in abundance on the farm, that one sometimes pays dearly for in a sanitarium?
2. What is the object of sweeping and dusting? How is this object best accomplished?
3. For what reasons are clothes washed?

### Arithmetic:

1. Dishes must be washed in the average home 3 times per day, 365 days in the year. If 30 minutes are required after each meal to wash the dishes for a family of five, how many hours of time are required in one year?
2. If by the addition of such conveniences as a sink, hot water, etc., 10 minutes could be saved each time the dishes were washed, how much time would be saved in a year?
3. If ten hours are spent each week washing and ironing for a family of five, how many hours of hard work could be saved in a year if the washing and ironing were done at a laundry?

## VENTILATION.

**Need of Air.**—Man or animal may live some time without food, even without water, but neither can live more than a few minutes without air. Air once breathed has lost much of its sustaining and invigorating element. Mr. King, in his book on ventilation, in dealing with this point, gives as illustration, instances of horses suffering from breathing impoverished air while working in the open field. This, he says, may occur where three horses, driven abreast, so hold their heads that the middle horse must breathe the air thrown out by the other two horses. The air once breathed is adulterated with

carbon dioxide, and may, usually does, contain numerous disease germs.

**Effect of Insufficient Air.**—When our bodies need food we are conscious of an uncomfortable sensation, that of hunger or thirst. We understand Nature's demands and seek to satisfy them, but her calls for fresh air are not always so well understood or so promptly answered.

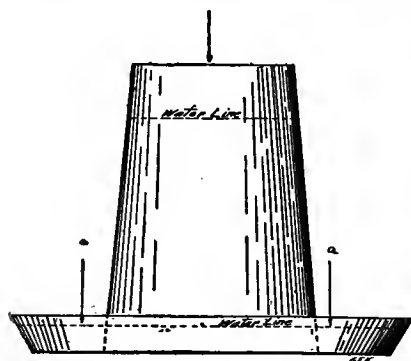


Fig. 107.—Glass full of water inverted in a saucer. The atmospheric pressure at aa holds the water up in the glass. Air will hold a column of water 30 ft. high in this way.

We often remain many hours in a room not properly ventilated, where we breathe and re-breathe the air, and wonder why we feel so drowsy and dull. Or we sleep at night in a room not sufficiently supplied with fresh air, and then wonder why we arise in the morning with a headache or a general feeling of weariness. Of course, the dullness and the headache may be due to some other cause, but too often we wrongly attribute such sensations to other causes. Unless we are perfectly certain that we have been breathing fresh air,

it would surely be wise to consider such sensations as Nature's demand for fresh air.

We supply our bodies with nourishment by eating and drinking. The only way of supplying them with oxygen, the element without which we could live only a few minutes, is by breathing air containing a large proportion of oxygen.

**Amount of Air Needed.**—An average man breathes about twenty cubic feet of air in one hour, and animals about the same in proportion to their weight. It would not take long for even a few people to breathe all the air of a small room, especially if a fire and a light were also consuming oxygen. We can then readily see how soon eight or ten head of cattle would breathe all the air of an ill ventilated barn.

But long before all the air has passed through either human lungs, or, in case of a barn, through the lungs of animals, it has become contaminated by the first few breaths, so after the first few minutes we are breathing adulterated air—fresh air mixed with air once breathed. The foul air is charged with water, carbon dioxide and germs, and is heavier than the fresher air; so it gradually settles to the floor, thus making it impossible for us to get the fresh air, even if some still remains near the ceiling. For this reason it is imperative that we have adequate means in both houses and barns for the foul air to escape and the fresh, life-giving air to enter.

**Air Pressure.**—Ventilation, which is simply a regulated movement of air, is brought about by the weight of the air, or atmospheric pressure. That air really does weigh something is illustrated by the following simple experiment. Try it:

Fill a glass with water and turn a saucer down over it. See Fig. 107. Invert the glass, holding the saucer firmly in place. It will be seen that only a little water escaped, merely enough to reach to the edge of the glass. The water does not escape, because of the pressure of the

air on the water in the saucer, while the bottom of the glass supports the air above the water. If you were to chip a little hole in the bottom or side of the inverted glass, the water would immediately run out, because the air pressure would then be equal both inside and outside of the glass.

### Questions:

1. In what condition is air after it has once been breathed?
2. About how much air does a person breathe in an hour?
3. Explain how all the air of a room may soon become contaminated.
4. Perform and write up the experiment showing the pressure of air.

### Arithmetic:

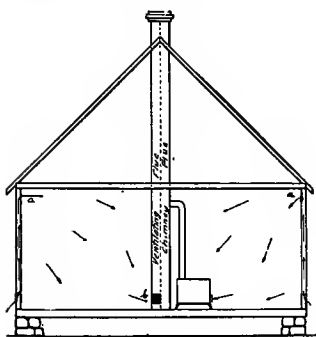
1. A man needs 20 cu. ft. of air per hour, how much does he need in 8 hours? How much air will two people need while sleeping in a room 8 hrs.?
2. If one needs 20 cu. ft. of air in an hour, how much will 40 children need in 6 hours?
3. How many cubic feet of air in a room 10x10 and 8 feet high?

### PHYSICS OF VENTILATION.

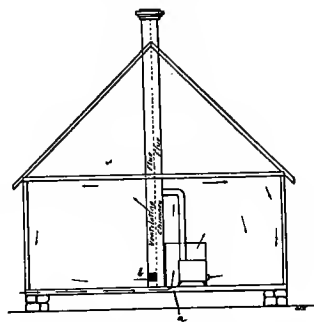
**Ventilation is Simple.**—We have learned that people and animals need pure and fresh air in order that they may be healthy. Supplying this fresh air is much simpler; especially in the country, than is generally supposed. To the boy or girl who has not studied physics or physical geography, it may not be plain at first. It is the object of this lesson to show, by facts that pupils already know, how pure air may be brought into a room and foul air expelled.

**Air Expands When Warmed.**—It is known that air moves about easily, and that it presses down, due to its weight, upon the earth. If for any reason the pressure is not the same on all sides, the air will move in the direc-

tion of the least pressure. Every pupil knows that when a fire is lighted in a stove the heated air and smoke will rush up the chimney. When air is heated it expands, hence becomes lighter. This may be illustrated by heating a bottle so that the air in it will be quite hot. Then place your thumb or the palm of your hand over the top of the bottle and allow the bottle to cool. Cooling may be hastened by putting the bottle in cold water, keeping your thumb or hand firmly over the top. As the bottle and the air it contains cool, you will feel a



108.



109.

Fig. 108.—Method of ventilating a school room when fresh air is taken in through the wall near the ceiling. Air movement indicated by arrows.

Fig. 109.—Method of ventilating a school room when fresh air is taken in under the stove, where it is heated, then diffused through the room. Arrows indicate movement of air.

pressure on the back of your thumb or hand, which will seem to be sucked into the bottle. This indicates that as the air in the bottle cools it contracts and occupies less space. It is evident then that cool air occupies less space than warm air, hence the statement that air expands and becomes lighter when it is heated.

**How Air Moves.**—Because air expands when it becomes warm, it is lighter in proportion to its bulk. The air moves somewhat as a pair of balances, the heavier end going down and the lighter end going up. When

some of the air is heated and some remains cool, it gets out of balance, and the heavier cool air pressing down around the lighter warm air forces the warm air upward. Hence, what we call draught in the chimney is caused by the heavier cool air outside forcing, by its greater weight, the light, warm air upward.

**Object of Ventilation.**—The problem in ventilation is not to remove the warm air from within buildings and let in cool air, but to remove foul air and replace it with fresh air without causing a draught. To explain this the principles explained above must be made use of. Also the fact that foul air is heavier than pure air and is usually found near the floor of the room.

**Ventilation Flue.**—A stove with dampers open is very good for taking foul air from a room, as it takes air from near the floor. When stoves are not used for heating, and to provide ventilation when stoves are not in use, a double flue chimney should be built, with one flue opening near the floor to remove the foul air, and the other flue to carry the smoke from the stove or furnace. The heat in the smoke flue warms the ventilating flue and aids in the circulation of air. In this way foul air is removed from near the floor, while warm air, which naturally rises near the ceiling, is not removed until it becomes foul and settles to the floor.

**Fresh Air Supply.**—To supply fresh air is very simple in rooms heated by the furnace, as the fresh air is brought in from outside, heated about the furnace and forced into the rooms. In buildings heated with stoves, steam or hot water, air must be brought directly to the room from outside, and the object is to do this without causing a draught of cool air on the occupants of the room. If this were not the case it would be a simple matter to open a door or a window and let in all the air needed.

There are two good methods of letting fresh air into rooms. The first and simpler is to let it in near the ceiling, as shown in Fig. 108, where it will spread out over the room and gradually settle through the warm



air, and as it becomes foul is drawn out through the stove or ventilating flue from near the floor. Another method, one frequently used in schools, is to have a sheet iron jacket about the stove. Air is let in under the stove, is warmed and rises between the stove and jacket to near the ceiling, where it spreads out over the room and is drawn from near the floor, as in the other case. See Fig. 109.

**Questions:**

1. How can you prove that air expands when heated, and is lighter than cool air?
2. What causes air to move up a chimney?
3. What is the object of ventilators?
4. Describe two good methods of getting fresh air into a room.

**Arithmetic:**

1. A cow requires about 115 cu. ft. of air per hour, how much does she require per day?
2. If a cow requires 115 cu. ft. of air per hour, how many cu. ft. of air do 20 cows need in 24 hours?
3. A barn 32 ft. by 60 ft. will shelter 40 cows. If the ceiling is 8 ft. high and each cow requires 115 cu. ft. of air per hour, how long will it take the 40 cows to breathe all of the air in the barn once?

**A GARDEN.**

**Value.**—A garden is a very small but important part of a farm. After the long winter, during which people have lived largely on bread, meat and canned vegetables and fruits, there is nothing more delightful than to get the fresh vegetables from the garden. Fresh fruits and vegetables are the most healthful of any of the foods. They are succulent, easily digested, palatable and nutritious.

A variety of good vegetables and fruits means much to every housewife, who must plan and prepare at least one thousand meals during the year. If she has at hand an abundance of fresh vegetables and fruits for

summer use, and of the same canned for winter, the question of preparing suitable and healthful meals is greatly simplified.

For the boy or girl who wishes to help his mother, and at the same time learn a great deal about soil and how to cultivate it; about plants and how to grow them, there is nothing on the farm that offers a greater opportunity than the garden. A very few minutes of well directed effort will work wonders in the production of many vegetables, such as radishes, onions, etc.

**Income from a garden.**—Some boys and girls, living near town, may earn considerable by caring for a few varieties of vegetables and selling the surplus in town. But every boy or girl has a good market for as much as he can

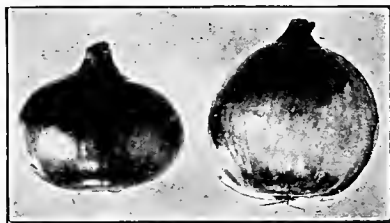


Fig. 110.—Flat onion on left, globe onion on right. Globe onions yield more than flat ones and usually sell better.

raise, right at home. He may not, and perhaps should not, expect to receive money for what he raises for home use, but he may rightly consider that he earns all that the vegetables would bring if sold. Vegetables and fruits have a value, whether sold or used at home.

Some farmers seem to think that their living costs nothing. It is true they do not pay out money for much of their food; but if they would consider, for example, the vegetables used worth what might be received for them if they were sold, every farmer would see what is used from a garden alone, during a summer, amounts to considerable, and that a garden is a very important part of a farm.

Work is more pleasant when we have an object in view, understand what we are doing, and are looking forward to definite results. The boys and girls may like to keep an account of the amount and value of garden produce used, to see how much a garden is really worth. Pulling weeds

may prove less tedious to a boy who is thinking of how, by his efforts, he is increasing a yield which he is going to record.

**An account with the garden.**—To keep an account of the garden produce, any note book of convenient size may be used. Devote one or more pages to each variety of vegetables. Each boy or girl should consult his parents and agree upon a price for each variety of vegetables—such as three cents per dozen for radishes and green onions, one-half a cent a head for lettuce, fifteen cents a peck for peas, string beans, etc. On the page of the account book devoted to radishes, record the price agreed upon for radishes; and it might make it more interesting to record also the date when the seed was sown.

As soon as any variety begins to yield, put down on the page devoted to it the date it was first ready for use and the amount gathered. During the summer each boy or girl will find out from his mother at night what vegetables were used that day and the amount of each gathered, either for immediate use or for canning, and record the date and amount.

In the fall, when everything has been gathered from the garden, your note book will show the amount and value of each variety used, sold, or stored. The sum of the values of all the varieties of vegetables will be the value of the garden.

### Questions:

1. Why is a garden important?
2. How does a good garden help the mother?
3. How is it of value to a boy or girl?
4. How may we find the value of a garden?

### Arithmetic:

1. How many dozen carrots in 3 rows 121 ft. long, if the carrots are 2 in. apart in the row? How much are they worth at 5 cts. per dozen?
2. What part of an acre is occupied by 3 rows of carrots 121 ft. long, if each row occupies a space 12 in. wide? (There are 43560 sq. ft. in an acre.)

3. If a boy spends 2 hours each week for 8 weeks in caring for 3 rows of radishes 121 ft. long, how many hours will he spend? How much is his time worth at 10 cts. per hour?

#### PLAN OF GARDEN.

**Location.**—As many trips are made to a garden during the summer, it should be so located that access to it from the house is easy and convenient; and, instead of being located in some little corner where most of the work must be done by hand, it should be accessible from the barn or field, so that most of the work may be done with a horse and cultivator. A good place for a garden is on a south slope sheltered by a grove.

**Size.**—There is waste land on most farms; and, as long as this is true, there is no excuse for skimping the garden. The garden should be of sufficient size that room may be given to each variety of vegetable, to permit of cultivation with horse labor. A strip about a rod wide at each end of the garden should be seeded to grass, on which to turn when plowing and cultivating.

**Soil.**—The soil for a garden should be very rich and productive. More work is required per acre on garden than on field crops, hence the importance of getting good crops to pay for the labor. If grain is sown on soil that will produce but half a crop, six to ten dollars an acre is lost, while if but half a crop is raised in a garden, owing to the poor condition of the soil, many times as much is lost, because a good garden may yield from \$100 to \$500 worth of produce per acre.

**Preparation of Soil.**—Land for the garden should be heavily manured. From twenty to fifty loads per acre may be used. Well rotted manure is best, but other manure will do. It is well to plow in the fall, so that the land will settle down and be less likely to dry out. Fall plowing is also helpful in destroying dangerous insects and worms. Early spring plowing will do;

but, in either case, much disking and harrowing should be given the land in the spring, so as to make the soil very fine and mellow before the garden seeds are planted. This early harrowing helps to warm up the soil and kills many weeds; also retards the evaporation of moisture. It is a good plan to use a plunker or pulverizer to insure the breaking up of all lumps, as securing a fine surface soil makes planting and cultivating much easier.

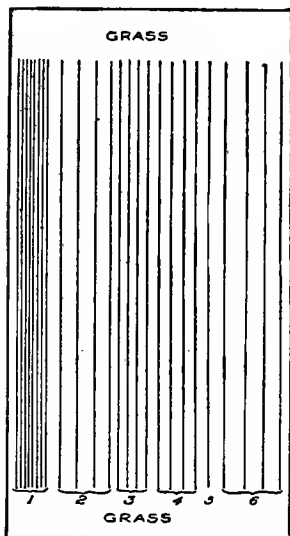


Fig. 111.—Garden arranged for convenient cultivation. 1. Rows 14 in. to 18 in. apart for onions, lettuce, beets, radishes, turnips, carrots, etc. 2. Rows about six feet apart for cucumbers, melons, etc. 3. Rows 3 feet apart for sweet corn, potatoes. 4. Rows 4 feet apart for strawberries, tomatoes, etc. 5. Asparagus 3 or 4 feet from other plants. 6. Rows about 6 feet apart for berry bushes.

**Arrangement.**—The rows should extend the long way of the garden. Vegetables which are planted in rows close together (12 to 20 inches) as onions, radishes, carrots, beets, lettuce, turnips, etc., should be on one side of the garden. Cabbages, beans, peas, sweet corn, potatoes, etc., with rows  $2\frac{1}{2}$  to  $3\frac{1}{2}$  feet apart, should be together. Such running vines as squashes, melons, and cucumbers, which require rows five to seven feet apart, should be together in another part of the garden. This arrangement allows the best use of the horse cultivator. If a row of onions and a row of potatoes were planted side by side, a good cultivation of the potatoes would be likely to cover the onions.

This plan also permits the best use of the small hand drill in planting and of the small hand cultivator in cultivating. Everything possible should be done, in the arrangement, planning and prepa-

ration of the garden, to reduce the amount of labor required to plant, cultivate and harvest the crop.

**Questions:**

1. For what reasons should the garden be located near the house?

2. What can you say about the soil and its proper preparation for the garden?

3. What arrangement would you make of the different crops in planting?

**Arithmetic:**

1. How many cabbages can one raise on an acre, if they are planted 2 ft. apart each way?

2. How many acres of land in a field 10 rods wide and 16 rods long?

3. How many rows of onions, planted with the rows 1 foot apart, can be planted on a field 10 rods wide? If the field is 16 rods long, how long will all of the rows of onions be?

## CHAPTER XII.

### FRUIT ON THE FARM.

#### VALUE OF FRUIT IN THE DIET.

**Succulent Food.**—That fruit is a healthful form of food is recognized by all, yet there are many people living on farms in the Northwest who seldom have as much fruit as is necessary for the health and comfort

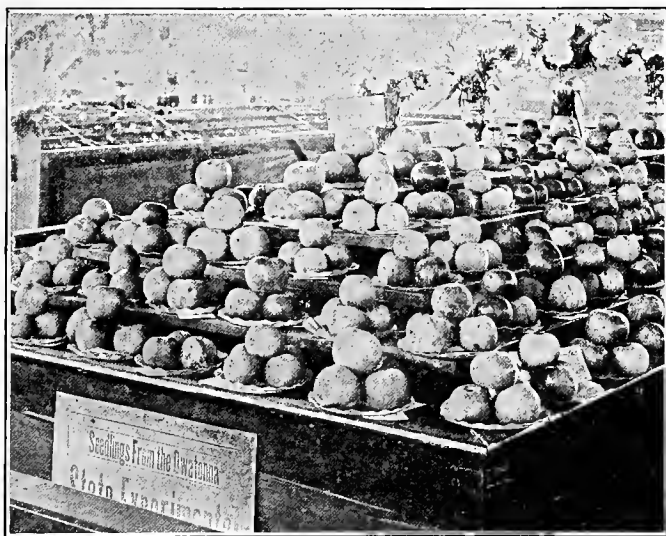


Fig. 112.—An exhibit of fine apples.

of the family. The need of succulent food for animals is met by supplying ensilage or roots, yet in many homes the need of succulence in the family diet, though as easily supplied, is apparently not recognized.

**Need of Fruit.**—The human body requires for proper maintenance, protein, carbohydrates and fat in proper proportion. Most foods contain these three nutrients, though but few foods contain them in the proper proportion. It is, therefore, necessary to eat more than one kind of food in order to get the nutrients needed.

The foods containing a large proportion of protein, or tissue-building and repairing material, are lean meat, milk, eggs, cheese, nuts, and legumes (peas and beans). Foods rich in carbohydrates, or energy or heat-producing elements, are the cereals, starchy vegetables (as potatoes and green corn) and sweet fruits. Foods rich in fat, the more concentrated form of heat and energy-producing food, are fat meats, egg yolk, cream, butter, etc. In addition to the protein, carbohydrates and fats, one needs some food to give succulence and bulk.

**Dietaries.**—A breakfast of bacon and eggs, warmed-over potatoes, toast and coffee, supplies protein, carbohydrates and fat, but lacks the bulky, succulent food that prevents over-eating of the other foods. Apples or oranges, where fresh fruit can be had, or a dish of apple, cranberry or prune sauce, if fresh fruit cannot be had, eaten at the beginning of the meal, would make the breakfast more healthful and also, perhaps, more palatable to the majority of people.

A dinner of cream tomato soup, pot roast, brown gravy, potatoes, bread, butter, etc., followed by a dessert of suet pudding or mince pie, is too heavy a meal, or at least heavier than any one needs. The soup, meat and potatoes furnish the protein, carbohydrates and fat in sufficient amount. All that is needed is the juicy, bulky food. This might be supplied by the addition of a succulent vegetable, as cabbage, turnips, onions, etc., or by a dessert of baked apples, canned peaches or pears, etc. It is well to follow a hearty meal with a light dessert, as fresh or canned fruit, while a hearty dessert may often supply the nutrients lacking in a light meal.



The supper following the breakfast and dinner given above need consist of nothing more than cream toast, a dish of sauce and ginger bread, or scalloped potatoes, bread, butter and preserves.

**Fruit Supply.**—Many families depend entirely upon wild fruit; and the scarcity of it some years, and the difficulty in procuring it any year, make it a luxury to be used only occasionally or to be saved for company. One of the first duties of the head of a family is to supply a comfortable, healthful living for those in his care. Good vegetables and fruits should be considered essential, and time spent in providing them should not be considered lost. Often a man might, by giving a little time to his vegetable and fruit gardens, provide his family with an abundance of such food, and thereby insure a good, healthful living. Is it not just as well for a man thus to provide food for his family as to raise a few more tons of hay or pounds of pork to sell to secure such food?

**Advantages of Home-Grown Products.**—The home-grown vegetables and fruits surpass any that can be purchased; for during the summer they may be had clean and fresh from the garden, and are very different from the dusty, wilted articles which are often all the markets have to offer. Such fresh fruit and vegetables are equally as much better than the market product when canned as when fresh.

Another great advantage in raising fruit and vegetables is that the family will then be well supplied, while there are few farm families that will pay the necessary price to secure the amount needed, if it must be purchased.

Every housekeeper knows the value of a good supply of fresh vegetables and fruit during the summer, and of the canned product for winter use. The jellies and preserves form a healthful and palatable dessert at any time, and are always ready. The canned vegetables are

soon prepared for use as such, or are quickly converted into soups.

Canned fruit juice, which may be had in large quantities where fruit is plentiful, is perhaps the most appetizing and healthful drink for the sick, and is equally as refreshing for those who are well.

### Questions:

1. What nutrients does the human body require for proper maintenance?
2. What foods are largely protein? Carbohydrates? Fats?
3. What kind of food do we need in addition to the protein, carbohydrates and fats?
4. What class of foods supply bulk and succulence?
5. What are the advantages of raising fruit for home use?

### Arithmetic:

1. If a family of six uses 1 qt. of canned fruit per day, how many quarts will they use in 6 months?
2. If a family of six uses the equivalent of  $1\frac{1}{2}$  quarts of fresh fruit per day, how many quarts would be required to supply them a year? How much are these berries worth at 10c. per quart?
3. If a man spends 5 hours per week for 12 weeks caring for fruit, to produce enough fruit for a family of six as given in example 2, how many hours would he spend? What is his time worth at 15c. per hour?

### STRAWBERRIES.

**Adaptability.**—The strawberry may be grown in almost any locality, from the far north to the extreme south. It is the most widely distributed of the cultivated fruits, and perhaps the most universally popular.

**Varieties.**—There are several hundred varieties of strawberries listed. Some varieties are particularly adapted to the cooler summers and to the soil conditions

of the northern districts, while others are adapted more particularly to the southern conditions. At least one or more varieties may be selected for any district.

There are varieties of strawberries that have imperfect or pistillate flowers, and varieties that have perfect flowers, or flowers containing both stamens and pistils. The perfect may be distinguished from the imperfect only by the flower. When buying plants, one must depend upon the knowledge and honesty of the dealer to secure either plants with perfect flowers or a sufficient number of them to properly fertilize the pistillate flowers. The pistillate varieties are often the best bearers, and are not objectionable when planted with staminate varieties, but are fruitless when planted alone. However, to simplify matters it is perhaps wise for the amateur to select from the perfect varieties.

**Soil.**—It is generally conceded that strawberries are most successfully raised on sandy or gravelly loam. Warm, quick soil is better than the heavy, rich soil, even if the former is lacking in vegetable matter, for this may be easily supplied, while it might be difficult to change the character of the latter soil. The plants thrive better on a light soil, and the fruit is of better flavor.

New clover sod makes a desirable soil for strawberries, but it is not safe to use old sod land, on account of the larvae of many injurious insects which are likely to be present in the soil and feed upon the young plants. To guard against such, it is well to have the strawberry crop follow some cultivated crop, as potatoes, beans or corn, for the cultivation is quite likely to kill the larvae.

**Preparation of the Soil.**—The land should be well fertilized. For four rows one hundred feet long, about what would supply the ordinary family, a load of well decomposed stable manure is needed. It is preferable

to plow this under in the fall. The surface should then be pulverized in the spring, when it is ready for the plants.

**The plants.**—Strawberries are propagated by runners. The runners grow out from the old plants, and at the joints take root and form new plants. It is these new

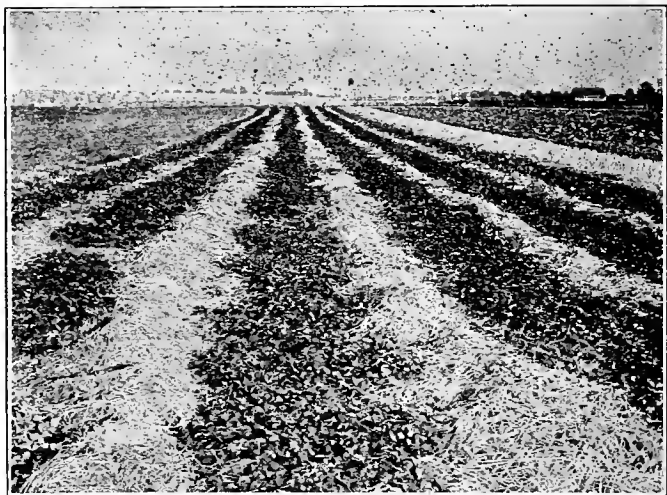


Fig. 113.—A strawberry bed with straw used for winter protection raked between the rows, where it holds moisture and checks the growth of weeds.

plants which should be set out. They are easily distinguished from the old by their white roots. Old plants have dark roots.

The plants, when taken up to be transplanted, should be trimmed of dead leaves or of too large a growth of leaves, and of all pieces of runners. Many roots are desirable, but as they may make planting difficult the large roots are usually trimmed.

If the plants purchased seem weak or wilted, or if the field at the time is exceedingly dry, they should not

be set immediately. It is much safer to shake them out well and put them close together in a row, where they may be easily protected from the wind and kept well watered. Here they will freshen, perhaps start to grow, and be ready for the field when conditions there are more favorable.

**Setting of Plants.**—Strawberry plants may be set out at any time, from early spring until as late as the first of June, providing the plants are strong and the ground moist. However, the earlier they are set the better, as they then have a longer growing season and the roots seem to form more abundantly in the cooler weather of spring. When necessary to do so plants may be set out in August, providing they are well rooted and the ground is well supplied with moisture. When buying for August planting, it is safer to buy potted plants, even though they are more expensive.

In setting the plants, the roots should be shaken or spread out as naturally as possible and the dirt firmly packed about them. Care must be taken to set the plants the right depth. The terminal bud should not be hidden, yet the upper portion of the root should be well covered. The safe rule is to set the plants as nearly as possible the depth they were before.

**System of Planting.**—Strawberries are either set in hills or in matted rows. When set in hills, they are usually three by three feet apart, or plants two feet and rows four feet apart. When set in matted rows, the common practice is to set out single rows four feet apart, plants twelve inches apart in the rows. The runners are then allowed to cover a space of from six to nine inches on either side of the plants, making a matted row from twelve to eighteen inches wide and leaving a space of from thirty to thirty-six inches between the rows for cultivation and convenience in harvesting. This space may be reduced, and there is one advantage in the narrower space—i. e., the runners may be allow-

ed to occupy it and the old row be plowed up. This saves resetting.

**Cultivation.**—Cultivation should be shallow, yet deep enough to destroy weeds and frequent enough to keep the surface well pulverized and to maintain a surface mulch. Moisture is then more readily admitted and evaporation is checked to a considerable extent.

Care must be taken to keep the plants from getting too thick in the row. If too thick they are less vigorous and produce smaller and poorer berries. When set in rows, enough new plants may be permitted to set to make a continuous row 12 to 18 inches wide, with plants not nearer together than 6 inches.

To protect the plants from frequent freezing and thawing, a mulch is applied. The mulch is usually of coarse material, as hay, corn stalks, or straw, and is applied late in autumn or in the early winter. It should protect the plants, yet not smother them. Ordinarily it should be about three inches thick and extend over the entire bed. In the spring most of the mulch is taken from over the row and put in the spaces between, where it preserves moisture and keeps down weeds. The portion left on the row aids in keeping the fruit off the ground.

### Questions:

1. What is the best soil for strawberries?
2. How should the soil be prepared?
3. What can you say of the plants to be set?
4. When and how should plants be set?
5. What care should the strawberry bed receive?

### Arithmetic:

1. If strawberry plants are set in rows 4 ft. apart and plants 2 ft. apart in the row, how long will four rows need to be to accommodate 200 plants? How much space will they occupy?

2. If strawberries yield 3,000 quarts per acre, how much is the crop worth at 10c. per quart?

3. If strawberries yield 3,000 quarts per acre, how many quarts should 4 rows 100 ft. long and 4 ft. apart yield?

## RASPBERRIES.

**Adaptability.**—The raspberry, like the strawberry, has some species which are adapted to almost every locality. One type of the red raspberry extends over a territory from Arizona to Alaska. There seems, however, to be no variety adapted to conditions in the western Dakotas, eastern Montana and Wyoming, or for parts of California, New Mexico and Texas.

**Varieties.**—The name raspberry, as we use the term to-day, embraces four species of plants, the European, a foreign species, the Native Red, the Black Cap and the Purple Cane, a cross between Black Cap and Red Raspberry. Each species has many varieties of fruit, but only two distinct types are represented, the red raspberries and the black raspberries or "black caps."

**Soil.**—In their wild state, raspberries are frequently found growing upon rocky soil, but they thrive better and yield more abundantly upon moderately rich soil. The varieties of red raspberries seem to require for best production a richer soil than most of the varieties of black raspberries, the former giving larger yields on moist clay loam and the latter on sandy loam.

**Preparation of Soil.**—Preferably raspberries should follow a cultivated crop. Beans, peas, and potatoes are good preparatory crops. Light, poor soil will require a heavy dressing of well decomposed barnyard manure, which should be thoroughly plowed under.

**Propagation.**—The red raspberries are propagated by root sprouts. Young succulent plants may be trans-

planted if a part of the parent root is taken with them, but one year old root sprouts are more successfully handled. The red raspberry is also propagated by planting pieces of the old root.

The black raspberries are propagated by stolons or layers. To secure new plants, the branches are bent over some time during the summer and their tips covered lightly with earth. They then root quickly. These



Fig. 114.—Uncovering raspberries in the spring. They are laid down in the fall and covered with earth to protect them from thawing and freezing.

new plants are left attached to the old plant until the following spring, when the old stem or branch is cut about eight inches above the new roots. The plants are then ready for transplanting.

**Setting of Plants.**—The red raspberries may be set out during either spring or fall, fall setting perhaps being more generally favored, as sprouts come out very early in the spring and are very liable to be broken off if transplanting is attempted at this season.



The black raspberries, tip rooters, should be transplanted in the spring, as they are almost sure to winter kill if disturbed in the fall.

Plants of either kind are usually set two in a hill, hills three feet apart and rows seven feet apart. If the rows extend north and south, the fruit during ripening time will be somewhat shaded by the new growth, which is an advantage. The spacing may be reduced, but wide spacing has some advantages, chief among which is the fact that it admits plenty of sunshine and makes cultivation possible even when the branches are bearing fruit.

When the new plants are set they are cut off close to the ground, and are not allowed to bear fruit the first year.

The red raspberries, propagated by root sprouts, should be set a little deeper than they were originally. The black raspberries, propagated by stolons or layers, should be set at about their original depth.

**Cultivation.**—Clean cultivation is especially necessary for the red raspberry, as it spreads rapidly if not checked, soon exhausting its vitality. Implements should be used to cut off the shoots or sprouts as they extend into the cultivated spaces. While the plants are young they should be cultivated both ways, but as they grow older it is perhaps more profitable to let them form a matted row or hedge. The spaces between the hedges should be plowed at least once a year, and perhaps less injury is done to the roots if spring plowing is practiced. The subsequent cultivating should loosen the soil only to a depth of two or three inches.

**Pruning.**—The red raspberries require summer and winter pruning. The summer pruning consists in stopping the young shoots when they are about eighteen inches high. This tends to produce branches and root sprouts and so increase the wood growth. The winter

pruning consists in cutting out all stems that have produced fruit, as well as all dead and diseased ones.

The black raspberry also requires two prunings. The spring pruning consists in removing the terminal buds when the young shoots are about eighteen inches high. They will then form from four to six lateral branches. To successfully prune, it will be necessary to go through the patch several times, taking each time only the buds from shoots of the right height. The second pruning is merely removing the old stalks, and may be done any time after the fruiting period. If done the following spring, then the lateral branches produced the previous summer may be shortened to about ten inches.

**Winter Protection.**—In some severe climates raspberries need winter protection. The roots are loosened at one side of each plant, and the top is bent over and covered with earth. A layer of corn fodder or straw may be added later, if more protection seems warranted. This covering should be removed in the spring, and the plants raised as soon as danger of freezing and thawing is past.

### Questions:

1. How general is raspberry culture?
2. How many types of raspberries are there?
3. What soil does each type require?
4. How is each type propagated?
5. Tell what you can of time and manner of setting each type?
6. Describe cultivation and pruning of each type.

### Arithmetic:

1. If one plants 4 rows of raspberries 100 ft. long, with 2 plants per hill 2 ft. apart in the row, how many plants are required?
2. If one has four 100 ft. rows of raspberries, rows 7 ft. apart, how much space do they occupy?
3. If raspberries yield 2,500 qts. per acre, how many quarts should one get from a patch 28 ft. by 100 ft.?

## CURRANTS AND GOOSEBERRIES.

**Varieties.**—There are three species of currants, the Red currant, the Black currant and the Crandall currant. Only the red currant has any considerable market in this country, and it includes red fruit and white fruit. There are not many varieties of currants listed, yet they differ considerably in degree of hardiness. Only varieties known to be hardy in the locality should be purchased for the main part of the crop.



Fig. 113.—Currant bushes tied together to prevent them from being broken down by snow. From Practical Fruit Growing.

**The Soil.**—Currants will produce fruit on very poor land, but do much better on rich land. The richer the land the larger the yield, all else being equal. Select any well drained piece of land, manure it if it is not already rich, plow and harrow until a good seed bed is prepared.

**Propagation and Setting.**—Currants are generally propagated either by cuttings or layers. The cuttings are usually made about seven inches long, from the new wood, as soon as the leaves have fallen, which is generally in August. They are then set in rich, well drained soil, with about one inch of the cutting above the surface of the ground and the earth well packed about the lower end. Here they will

take root, and in about a year be large enough to transplant in the permanent field.

Layers are made by bending branches to the ground early in the season and covering them with earth. These plants are separated from the old plants after they become rooted, and may be transplanted in the fall or the following spring.

Currants may be set out either in the fall or in the spring. If set in the fall they will need to be banked

slightly. They should be set so as to admit of cultivation both ways, five or six feet being the usual spacing.

**Cultivation.**—The space between the rows should be plowed every spring, and then cultivated frequently until the bushes are fruiting; when perhaps cultivation will have to be suspended. Cultivation should be resumed after the fruit has been gathered.

Often heavy mulching will serve quite as well as cultivation. The mulching may consist of straw, sawdust, ashes, etc. If sawdust or ashes are used, care must be taken to keep them from being worked into the soil. A combination of the two systems also produces good results, i. e., to mulch about the plants and cultivate in the center of the spaces.

**Pruning.**—Unlike raspberries, the older branches bear most of the fruit. Therefore the pruning should consist in taking out the oldest, weakest and diseased stems, and enough of the new shoots to keep the hill from becoming too crowded.

**Winter Protection.**—Most of the varieties are perfectly hardy, but a few of the varieties bearing large fruit may need to be bent and covered with earth. Bushes are protected from too heavy a burden of snow by being securely tied in an upright bunch.

**Gooseberry.**—The gooseberry is closely related to the currant. It does well on about the same kind of soil and requires about the same care.

**Propagation.**—Unlike the currant, the gooseberry is not successfully propagated by cuttings. Layering is the more successful method of propagation. If the old branches are carefully covered with soil in the spring, when the new growth is a few inches long, many new plants will be rooted by fall.

**Pruning.**—Gooseberries should receive the same pruning as the currant. In addition they should have the new growth cut back a little every year, as this tends to increase the size of the fruit.

**Questions:**

1. What kind of soil do currants require?
2. How are currants propagated?
3. What cultivation and pruning should currants receive?
4. How are gooseberries propagated?
5. What pruning should they receive?

**Arithmetic:**

1. If currants are set 5 ft. apart each way, how many square feet of land are required for 25 hills? What part of an acre is this?
2. If one has a row of currants 125 ft. long, and to cultivate it thoroughly he must go the length of the row four times, how far would he travel in cultivating his currants once? How long would it take him if his team traveled at the rate of 2 miles per hour?
3. If currants are set five feet apart each way, how many hills can be set in one acre?

**APPLES.**

**Adaptability.**—By selection and grafting, varieties of apples have been obtained which are very hardy and adapt themselves to wide ranges of territory and vast differences in temperature. Apple-growing is no longer confined to the warmer portions of the south, but is a possibility in the colder sections of the north. In fact some very choice apples are raised in districts of short summers and cold winters.

**Varieties.**—Varieties differ greatly in degree of hardiness. Some varieties are local, while others are more general. Patten's Greening, an apple originated in Iowa, and the Okabena, originated in Minnesota, are among the hardy American varieties.

**Soil.**—The chief requirement of soil for apple production seems to be that it contains an abundance of plant food. The poorer the soil, the more careful management becomes necessary. The best condition for

apples seems to be a rich, well-drained soil that will retain moisture.

**Preparation of the Soil.**—Some prefer to raise apples in a sodded tract. Where such is the case, good clover or prairie sod need not be broken up. Holes should be dug large enough to accommodate the tree without crowding its roots. Where cultivation of the orchard is planned, the soil should be brought into a tillable condition before trees are set. The latter is undoubtedly the more successful method.



Fig. 116.—Picking apples. Note care taken to prevent bruising as bruised apples do not keep well.

**The Trees.**—In selecting trees to set, perhaps more attention should be paid to the roots than to the shape of the top. The essentials are a good root system and a thrifty top.

Apple trees do not come true from seed. That is, seed from Ben Davis apples will not produce Ben Davis Apple trees. Trees true to variety are secured by grafting branches of trees of desired varieties on roots secured by planting apple seeds. In severe climates it is very essential that these roots be hardy.

To be sure of getting suitable stock, it is wise to order trees for planting only from dealers in whom you have confidence. Trees should not be more than four or less than one year old.

Trees for northern growers should be taken from the nursery in the fall, and kept through the winter in a cool cellar, or be buried in trenches in the field.

**Setting the Trees.**—In sections of severe winters, apple trees should be set in the spring as they are almost sure to winter-kill if set in the fall. In sections particularly adapted to apple culture, the trees may be taken from the nursery in the spring and set out. They may also be set in the fall. However, the spring planting is likely to be more successful than the fall planting.

The depth to set apple trees will vary according to the slope of the land and the quality of the soil. On steep hillsides they must be set deeply enough to prevent the roots from coming to the surface. In rich soil, four or five inches deeper than they were originally is adequate. Sandy light soil will require deeper setting.

In sections where apple trees grow large, they should be set from thirty-five to forty feet apart. In sections where trees do not attain so large a size, they may be set from twenty-five to thirty feet apart, and trees in one row alternate with those in the next. As a protection against sun scald, trees should be set to lean a little to the southwest.

**Cultivation.**—If cultivation of the orchard is practiced, some crop which requires cultivation in early summer but none in the fall, may be grown. Corn and early potatoes are often planted; and in some eastern states, where there is a great demand for tomatoes for the canneries, this crop is found profitable, and the cultivation beneficial to the orchard.

**Mulching.**—There are arguments for and against mulching. Where cultivation is impossible, a mulch of straw, hay or any coarse material, should be maintained. A mulch of stable manure is beneficial to young trees, but should not touch them.

Where mulching is practiced, it should be renewed when grass begins to grow up through it, and should cover as large or a larger space than the roots are liable to permeate.

Each spring the mulching should be removed, the ground around the tree well spaded, and a mulch replaced.

The chief objections to mulching are that it tends to encourage growth of roots towards the surface, and furnishes a home for injurious insects. These objections may be overcome by removing the mulch in the spring and replacing it in the fall.

**Pruning.**—The objects in pruning are to admit sunlight, which is necessary to ripen the fruit, and to maintain the vigor and vitality of the tree. Trees well exposed to sun and wind will need less pruning or thinning of branches than trees in more sheltered places. Old, neglected trees may be benefitted by pruning, as the remaining branches will receive more of the sap gathered by the roots as the foliage area is reduced. If the trees are badly in need of pruning, it is well to remove only a portion of the surplus branches the first year, and continue the pruning the following years.

A limb that crosses another, or is too near another, should be removed as well as all diseased portions.

Pruning may be done on warm days in early spring. It is safer not to prune when the twigs are frozen, yet the pruning should be done before the sprouts start. A branch or twig should be cut off close to the trunk or the branch, as such cuts heal more quickly than if a stub is left. The scars made should be covered with grafting wax or some similar substance. Pure linseed oil and white lead are successfully used.

### Questions:

1. How has apple-growing been made possible in districts not originally adapted to it?
2. What kind of soil do apple trees require?
3. How are different soils or sods prepared for apple trees?
4. Tell what you can of trees suitable for setting.
5. How and when should trees be set?



6. What cultivation is necessary?

7. What mulching and pruning are necessary?

**Arithmetic:**

1. If trees are set 25 ft. apart each way, how much space does each tree occupy? How many trees can be set on an acre?

2. If trees are set 25 ft. apart each way and each tree produces 4 bu. of apples, how many bushels will be produced per acre? How much are they worth at \$1.00 per bu.?

3. If one has 10 apple trees, each producing four bushels of apples, how much will the apples be worth at 90c. per bu.?

**PRESERVING FRUIT.**

**Fruit for Winter.**—In sections where berries are not grown the year around, the only way of having them, and many of the larger fruits, during winter is by summer canning or preserving. Perhaps no work the housekeeper does is more interesting and profitable than filling fruit jars and jelly glasses. To can successfully is not difficult if the essentials are understood.

**What Causes Loss.**—There are three living organisms, the presence of any one of which will cause decomposition of animal or vegetable matter. These organisms are too minute to be detected by the naked eye, but their effects upon food are familiar to every housewife. The three organisms are yeasts, molds and bacteria, and they are found in air, water, soil, and on animal and vegetable substances.

**Yeasts.**—When yeast plants are present, they will begin to grow if conditions are favorable to their development. Conditions necessary seem to be presence of warmth, air, moisture and sugar. The plant grows by budding, i. e., a little plant starts out from the parent plant and is soon as large as the parent plant. It separates from the parent, and this process continues as long

as conditions remain favorable. They will grow in fruit juice and fruit slightly sweetened, but not in thick sirups or preserves. They are easily killed by exposure to high or low temperatures.

**Molds.**—Every house wife is familiar with mold as it occurs on bread, cake, etc. The spores (seed) of molds are very light and may be floating in the air. When a spore lodges on a warm, moist surface, it will soon germinate. It grows by sending slender fibers into the food upon which it is lodged. Soon the surface is covered. It is killed by exposure to high temperature for fifteen or twenty minutes.

**Bacteria.**—These organisms multiply most rapidly in meat, milk and the legumes. They do not grow in acids or thick sirups. Therefore pickles and canned and preserved fruits are more liable to be injured by yeasts and molds than by bacteria. The bacteria themselves are easily destroyed by heat, but to destroy their spores high temperature must be maintained for several hours; which is the reason for the long cooking of peas, beans, and corn.

**Conditions of Fruit.**—Only the very best fruit should be selected for canning. All fruit, except the gooseberry, should be canned when ripe but not over-ripe. The gooseberry is often canned or preserved when green.

Pectin, a carbohydrate resembling starch, is an important factor in juice of ripe or nearly ripe fruit. When equal amounts of sugar and fruit juice are combined and heat is applied, the pectin causes the mixture to gelatinize, thus forming jelly. This power to gelatinize is strongest in juice of fruits that are just ripe or a little under-ripe. For this reason, fruit intended for jelly must not be over-ripe.

**Preparation.**—The great essentials for successful canning and preserving are cleanliness and sterilization. To lessen the amount of germ-laden dust in the air, the kitchen should be swept and dusted before the fruit is taken into it. Kettles, jars, strainers, covers, rubbers,

and all utensils to be used should be scalded or otherwise sterilized. Careful attention should be given to the fruit itself. Soft fruits, as raspberries and strawberries, when washing is necessary, should be put in a colander and cold water poured over them.

**Methods of Canning.**—For canning, fruit may be cooked in hot water, in the oven, or may be stewed. Small fruits, as berries, retain their shape better when cooked either in water or in the oven.

When the hot water method is practiced, the fruit-filled jars, with their covers lightly placed, are stood in warm water, which is then slowly brought to boil. The chief objection to this method is that any gases formed do not pass off, because of the covers, but are reabsorbed by the fruit. For this reason the oven canning is more satisfactory.

**Sirups for Canning.**—The amount of natural sugar in fruit varies from season to season. The warmer and more favorable the season, the sweeter will the fruit be, and it will require less additional sugar. Tastes also differ; so it is impossible to give proportions for sirups that will fit all conditions and suit all tastes. Equal parts of water and sugar is a general rule. Put the sugar and water together and stir until the sugar is dissolved. Heat slowly, then boil for fifteen minutes without stirring.

**To Can Raspberries and Strawberries.**—First place in the bottom of the oven something to lessen the danger of jars breaking. A shallow pan of hot water or an asbestos mat may be used. Make the sirup, sterilize the jars, heat them and fill them with the prepared fruit. Pour into each jar as much of the hot sirup as it will hold. Put the jars in the oven and leave until the sirup boils. Remove and put on sterilized rubbers and covers.

**To Can Currants.**—Currants require about one third as much sugar as amount of berries to be canned. Mash, heat and strain out the juice from a small portion, (about one sixth) of the currants. Add the sugar to this juice

and put on the stove, and stir until the sugar is dissolved. When this juice boils, put the remaining currants in it and boil about ten minutes, counting the time they actually boil. Skim well while boiling. Put into sterilized cans and seal.

Raspberries are very palatable canned in sirup made of currant juice as given above.

**To Make Grape Juice.**—Crush the cleaned and stemmed fruit in a kettle. Boil about thirty minutes. Crush the fruit with a wooden spoon and strain off the juice. Boil and skim the juice. Add the sugar in the proportion of one part sugar to six or eight parts juice. Boil about five minutes, skimming meanwhile. Put into bottles or jars and seal.

Other fruit juices are made the same way. Currants, however, require about one part sugar to two parts juice.

### Questions:

1. Name and describe the organisms which cause decay and fermentation.
2. What should be the condition of fruit for canning? For jelly, and why?
3. What are the essentials of successful canning?
4. Describe the hot water method of canning. The oven method.

### Arithmetic:

1. If 24 quarts of fresh strawberries worth 10c. per quart are required to make 12 quarts of canned berries, how much do the berries cost for one quart of canned berries?
2. If 2 hours time is required to can 12 quarts of berries, what is the cost of the labor per quart if time is worth 12c. per hour?
3. If 18 lbs. of sugar costs \$1.00 and 1 lb. of sugar is required for 1 quart of canned strawberries, how much does the sugar cost per qt. of berries?
4. What is the total cost of one quart of canned strawberries? (See three examples above).

## CHAPTER XIII.

### COUNTRY ROADS.

#### THE ROAD PROBLEM.

**Importance.**—Few boys and girls realize the great importance of roads. As one walks over them to school day after day he is liable to think how bad or how long they are, rather than to think what they are for, how they are made and how maintained.



Fig. 117.—A well-kept highway at Northfield, Minnesota. Trees are beautiful, and often a comfort to man and beasts. On heavy soil, too many trees shut out sun and wind and keep the road soft and muddy.

There are from twenty thousand to eighty thousand miles of roads in each state, and there are many millions of tons of farm products hauled over them each year. Whether these roads are good or bad makes a great deal of difference in the amount of labor required to market these products, and consequently in the prices that must be charged for them.

**Uses of roads.**—Roads are used as a means of communication also, and as roads become better it is easier for people to travel about. Therefore, where roads are good, people can with less effort and much greater comfort go to school, to church, to town and to their neighbors. Such conditions make life pleasanter in the country and have a very strong tendency to make property more valuable. Good roads have an educational and social influence of quite as much importance as their economic value.



Fig. 118.—Showing a well-kept and a poorly-kept roadside, indicating a careful and a careless farmer.

Really good roads are seldom seen in the Northwest except during the time when weather conditions are favorable. A good road is one that is good at all times, not merely when all conditions are favorable.

**Cost of roads.**—We often hear the remark that roads are poor because it costs too much to build good ones. But did it ever occur to you that bad roads may cost more than good ones? All products of the farm must

be transported over roads, and it may cost more to haul these products to market for several years, over poor roads, than to both build good roads and haul the products over them.

**Points to consider.**—Are the roads good between your home and the school house? Between your home and town? Are there steep hills, or places where the road is rough, or muddy, or sandy? Have you thought that the size of the load that can be hauled to town is determined by the size of the load that can be hauled over the worst place or places? This is true; and many times one has to go to town with only half a load, because of some bad place in the road. This increases the cost of marketing farm products, consequently it has a tendency to increase the price of things sold from the farm, because if the roads are bad fewer products can be brought to town and fewer farmers will try to get products to market. People who live in town and have to buy the farm products are interested in good roads, because they want to get their vegetables, flour, etc., as cheap as possible. For this reason it is right to tax all the people in the county, state or in the United States, for the purpose of building good roads, because all of the people are benefited by them

Roads in the Northwest are nearly always four rods wide. This takes a great deal of land. A strip two rods wide is taken off all land adjoining a highway. They are made this width to give ample room for turning and to allow space for ditches, cuts and fills.

**Appearance of Road.**—Some farmers take pride in keeping the side of the road adjoining their farm clean of weeds and neat in appearance. One of the ways by which people, passing, judge a farmer is by the appearance of the roadside along his farm.

### **Questions:**

1. In what way do poor roads affect the price of farm products?

2. Why is it right for people living in town to pay part of the expense of building good roads?

3. Explain how poor roads may be more expensive than good ones.

4. What are some of the advantages of good roads besides making it easier to market farm products?

**Arithmetic:**

1. If ten teams pass over a road each day, how many trips will be made over the road in a year?

2. If 3650 trips are made over a road each year, and there would be a saving of 2 cts per mile each trip if the roads were good, how much would be saved per mile per year?

3. If \$1,000 per mile were invested in good roads, and \$73.00 were saved annually thereby, how long would it take to pay the \$1,000, drawing 4 per cent. interest by applying the \$73.00 saved annually?

**SYSTEM OF DOING ROAD WORK.**

**Poll Tax.**—You have doubtless heard your father speak of working out his poll tax. This is a tax that every man between the ages of twenty-one and fifty (old soldiers excepted) must pay or work out to keep the roads in repair. The tax consists of not less than one or more than four day's work. It is left to the voters in each township to decide the number of days of labor each man shall be taxed, and whether this tax is to be paid in labor or its equivalent in cash. In many of the townships this tax is still paid in labor. In addition to the poll tax, each real estate owner is required to pay a small tax in cash or in labor, to be expended on the roads. This is known as the land road tax.

**Cash Tax System.**—During the last few years a great many townships have voted to pay all road taxes in cash and to hire men to make and repair roads. This is a very much better way than for each farmer to go out on the road for a few days each year, for the following reasons: First, competent men can be hired to look after the road work—men who have had experience and who do enough such work each year, so they can afford to study and know the best ways of doing road



work. Second, road work can then be done when it is most needed. When each farmer works out his poll tax, all road work is usually done in the early summer, between haying and seeding time, and the roads are then left to take care of themselves the rest of the year. The old saying, "A stitch in time saves nine," certainly applies to road work.



Fig. 119.—A Badly Drifted Road.  
With continuous supervision of highways such roads would be promptly and properly opened.

When a small rut is formed in a road, a shovelful or so of material will fill it, but if it is left, water will settle into it and soften the road bed. Then every time a wheel passes through the rut it lifts some mud out with it and makes the rut deeper, until finally several loads of dirt are required to fix the place. A shovel of material at the proper time would have fixed the place and have kept the road good all of the time. Thus an experienced road overseer, who can look after the roads at all times and has the cash with which to hire men and teams just when they are needed, can give

much better results in road work than can be given under the poll tax system. Third, men and teams can be hired to do the road work who are familiar with that kind of work. When several farm teams are put together to work in the road, the horses are not used to the work or to working together, consequently they cannot do

so much or do it so well as can teams that are doing that kind of work most of the time. Fourth, under the poll tax system men are obliged to leave their work on the farm and work on the road. Under the cash tax system they can pay their tax and stay at home to attend to their crops. This is much more important now, when farmers are practicing diversified farming, than when they were raising only grain.

**Other Money For Roads.**—Any township may appropriate money for road work to the extent of a certain per cent of the assessed valuation of property in the township. Counties may also appropriate money for roads, and the states are at each session of the legislature appropriating money to improve highways. There is also in many of the states a permanent road fund accruing from the sale of land.

The total amount of money expended on roads is many millions of dollars annually, and whether or not this money is wisely expended means a great gain or loss to all the people. It is hoped that some of the young people who read this chapter will become interested in the subject of good roads, and be constantly looking for better ways of doing road work.

It would seem that the important thing in road work at present is to adopt a system that will make it possible to hire competent men to look after the roads constantly.

### Questions:

1. What do you understand by the term poll tax?
2. What do you understand by the term cash tax system?
3. What are some of the advantages of having the road taxes paid in cash?

### Arithmetic:

1. It costs a farmer about 17 cents per ton to haul farm products one mile on dirt roads as they now exist in Minnesota. What does it cost him per ton to market his products on such a road, at an average distance of five miles? What is the total cost per year, if he markets 50 tons of produce?

2. It costs about 13 cents per ton to haul farm products one mile on graveled or on well built and well kept dirt roads. What will it cost per ton for a distance of 5 miles? What will be the total cost per year if 50 tons of produce are hauled to market?

3. There are about 3 farmers to every mile of road. If each farmer is saved \$10 per year by being able to market his products easier, how much are the three saved?

4. If the three farmers borrow \$500 at 4 per cent interest and spend it to improve the mile of road, how long would it take them to pay the \$500 and interest if they paid on it the \$30.00 saved each year by having good roads?

#### ROAD CONSTRUCTION.

**The object** in view in road building is to make the road bed as near level as possible, that is, to avoid hills; also to make and keep it as firm and unyielding as possible with the material and labor at hand. It is sometimes no farther around a hill than over it, and in such cases it is much more practical to go around. A pail bail is often used to illustrate this point. When standing erect the bail is the same length as when lying down, but a road, as represented by the erect bail, would be much harder to travel than a road represented by the bail lying flat.

**Stone Roads.**—In the older countries, and in the older and more thickly populated portions of this country, a large portion of the roads are built of some hard material, as stone. A very common form of stone road is called macadam road. It is named after the man who invented this process of road building. To build a macadam road, the road bed is first given the slope desired, then covered with a layer of coarse, crushed rock, which is rolled with a heavy roller. Then another layer of finer crushed rock is placed on top, and rolled until it works in between the particles of the coarser material. More, but still finer, crushed rock or sand is added,

sprinkled with water and rolled until a smooth, hard surface is formed. A stone road made as above described, and from 6 inches to 12 inches thick, makes an excellent, hard, permanent road. Such roads cost so much (\$3,000 to \$6,000 per mile) that they can be built only where the population is dense and where there is a great deal of travel over them.

**Dirt Roads.**—In most farming districts, for many years to come, roads must be made of the material at hand; which means, in most cases, common dirt roads. Such roads, if properly made and maintained, are very

serviceable and may be much better than country roads generally are.

**Drainage.**—Since the object in view in making roads is to keep them hard, it is plain that to do this water must be kept from standing at or near the surface. Drainage, then, is the first problem in building roads (except sandy roads) and it is

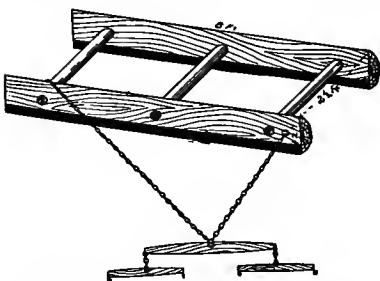


Fig. 120.—A Split-log Drag faced with steel. (See description and cost page 320.)

safe to say that if all roads were properly drained the greatest problem in road building would be solved.

**The Turnpike.**—The most common form of road is a turnpike, made by taking dirt from either side of the road and putting it in the middle. This makes a very good form of road, as the center of the road is high, so the water runs off to either side into the ditches formed. Often water remains in these ditches because no outlet is provided by which it can escape into the natural waterways. Water standing beside a road, and within two to four feet of the surface, is very often detrimental to the roadbed, as it soaks up through the dirt and keeps it soft. It is sometimes necessary to

ditch across some farmer's land to get the water out of these roadside ditches. Farmers should willingly co-operate with the town board to do such work. Instead, they sometimes object. But in most states the town board is authorized by law to construct such ditches as are necessary across any property. They, of course, must pay damages if such ditch does damage to the property; but if it proves a benefit, then the owner of the property must help pay the cost of constructing the ditch.

Where the road is made mostly of clay it is greatly benefited by the addition of sand, as the mixture is less sticky, sheds water better and dries out more quickly. Likewise sandy roads are benefited by covering them with clay, as the clay helps to bind the sand together and keep the road hard.

If good gravel is at hand, that is sharp and will pack together, almost any of the common dirt roads will be benefited by a coating of it.

Good gravel roads are better than dirt roads, but not so good as stone roads. They are much cheaper than stone roads; and many communities are graveling a few miles of road each year, thereby gradually getting a very serviceable system of roads.

#### Questions:

1. What is the chief object in view in road building?
2. Tell how a macadam road is built.
3. What is the first problem to consider in constructing dirt roads?
4. Why is a turnpike a good form of road?

#### Arithmetic:

1. If a road is four rods wide, how many sq. ft. of surface are there on a mile of road?
2. If there are 30 inches of rainfall in a year, how many tons of water fall on a mile of road in a year? (A cu. ft. of water weighs 62.42 lbs.)
3. How many cu. yds of gravel are required to cover a mile of road 12 ft. wide and 6 in. deep?

## MAINTENANCE OF ROADS.

**Road Repairing.**—In well settled communities the main part of road work is to keep roads in repair. Repair consists of fixing bridges and culverts, filling in ruts and mud holes, opening up old and making new side ditches, and smoothing off and rounding up the road bed so it will readily shed water. After a dirt road is well made—that is, made as level as practicable under the circumstances and built into a turnpike with ditches on either side—there is nothing so cheap and effective for keeping such a road in repair as the split log drag.



Fig. 121.—The split-log drag in use. Notice ruts made by wagon wheels. A road should be dragged, if possible, before it gets in such bad shape.

**King's Split-log Drag.**—Every one interested in good roads should know of the King split log drag. It is named after Mr. D. Ward King, of Maitland, Missouri, who first made known to the public the value of this excellent little implement. It is made of a log 10 inches or 12 inches through and about eight feet long, split in halves. The halves are fastened together by

boring 2-inch holes through them and driving in strong stakes two and one-half to three feet long, just as a wood-rack bed is made, with both split surfaces of the log facing the same way. If a log is not at hand, a timber about 3 inches by 8 inches may be used instead. The efficiency of the drag is increased by putting a strip of steel on each cutting edge as shown in Fig 106. The drag then cuts better and wears much longer. The drag is drawn by a chain in the direction of its faces, and at an angle, so that it pushes dirt toward the center of the road just as a reversible road grader does.

**Why Dirt Roads Need Dragging.**—When a road is first made it has a gradual and continuous slope from the center towards the sides. This leaves no place for water to stand on the road, and it soon dries off after a rain. As heavy loads are drawn over dirt roads, the wagon wheels cut into the surface and throw up a ridge of dirt just outside of where the wheels run. You can see this on almost any road, especially after a rain. If these wheel tracks are allowed to remain, when it rains water will stand in them and soften the road bed. Then as wagons pass over them they are made much deeper. The road drag is the simplest way of filling these ruts. It is cheaply constructed, and one man and two or three horses can handle it.

**When to Use a Road Drag.**—You have no doubt heard of “puddling soil”—working it when it is wet. Farmers sometimes make reservoirs for water in clay soil by excavating a hole, wetting the soil in the bottom and tamping it or leading horses or cattle about in the muddy bottom. This puddling makes the soil hold water. Since we want the surface of the road to be impervious to water, it is desirable to have it puddled. This can best be done by dragging it soon after a rain, when it is still wet. If a puddled surface will hold water, as in the case of reservoirs, it will also shed water when rounded and smoothed, as on a dragged road. There are also other reasons for dragging at such a time. The surface of the road is soft and the ridges are

more easily cut off and pushed to the center. Men and teams can not work to good advantage in the fields, and the road dries more quickly. When all main traveled dirt roads are dragged soon after every heavy rain, roads will be very much better than they are now, and the cost of this work is so slight that any well settled farming community can afford to do it, or each farmer can well afford to drag the road along his property.

If a hole is to be filled in a road, material similar to the road should be used, i. e., it is not wise to fill a



Fig. 122.—Same road shown in Fig. 121, after dragging twice.

hole in a clay road with sand or a hole in a sandy road with clay, as they do not wear uniformly and consequently make the road rough.

**Sandy Roads** are best maintained by keeping them covered with straw or other vegetable matter, as this helps to hold moisture, and sandy roads are firmer when moist than when dry. The Minnesota State Highway Commission suggests that the road supervisors in sandy sections sow some strong growing crop in the right of way, to cut and throw in the road.

#### Questions:

1. Describe a King split log drag.
2. For what reasons do dirt roads need dragging?



3. What is accomplished by dragging a road when it is still a little wet?

**Arithmetic:**

1. How many feet of lumber in two timbers 3 in. thick, 10 in. wide and 8 ft. long? What is it worth at \$30.00 per M. feet?

2. What will a strip of mild steel  $\frac{3}{8}$  in. thick,  $2\frac{1}{2}$  in. wide and 16 ft. long, weighing 3 lbs. per ft., cost at 3c per pound?

3. A boy can make a road drag with the above materials in 5 hours. His time is worth 10c per hour. What is the cost of the drag, including timber, steel and labor?

4. A boy with three horses can drag a mile of road in 1 hour. How much will it cost if the boy's time is worth 10c. per hour and each horse's time is worth 8c. per hour? How much will it cost if he drags the mile of road 5 times during the year? If he drags it 10 times?

## CHAPTER XIV.

### CO-OPERATION.

#### FEATURES OF CO-OPERATION.

**Meaning of Co-operation.**—Every farm girl and boy should know the meaning of the term co-operation and realize its full significance. Co-operation means united effort or, as Prof. J. A. Vye has put it, "Union of the powers of the common people for the common good." The very best example we have of true and ideal co-operation is in the family. Here each member works for the common good, makes sacrifices for the rest, and shares



Fig. 123.—Young people learning to co-operate. Exhibits and exhibitors at a Douglas County Industrial Contest.

in the joys and successes of the other members. In our business relations with neighbors and friends we cannot expect such complete co-operation. But under present conditions of business, it is possible for people to co-operate or work together to their mutual advantage, even if they are prompted only by advantage to themselves and are without the generous desire to help others.

There is perhaps no other class of people that co-operate as little as do farmers, and likewise there is probably no class who can be benefited more by co-operation.

**Obstacles to Co-operation.**—One of the great obstacles to co-operation among farmers is the old notion, retained by many, that a farmer is the most independent man on earth. It is true that the farmer is independent in some ways. He is his own employer, may go to work an hour late or quit an hour early occasionally without asking anyone's permission. On the other hand he is dependent on other people to buy his products; and, to get his supplies, he is dependent on manufacturers, transportation companies and merchants.

**Need of Co-operation.**—It is a safe conclusion that in the majority of cases the weaker of two persons making a trade comes out second best. The farmer in selling his products and in buying his supplies usually deals with large concerns, consequently he very often gets the worst of the bargain. This is but natural, for the business of the average farmer amounts to but very little to the buyer of stock or grain, and while the sale may mean a great deal to the farmer, it means very little to the buyer. Likewise a dealer selling machinery, lumber or other supplies does not care a great deal about the business of one farmer, but the farmer is often under the necessity of buying of that particular dealer. In the above mentioned cases it is quite evident that the farmer is at a disadvantage.

**Advantages of Co-operation.**—If, however, several farmers go together and offer for sale a large amount of grain, stock, or other products, there is business enough represented in handling this product to attract several buyers, and as a consequence a better price is obtained. Likewise, if a number of farmers find that they need among them several machines of different kinds (probably a few thousand dollars worth) and they go to a dealer to buy, he is anxious to get the large order and will make some reduction in price in order to get it. Such combination of interests tends to equalize the strength on the two sides of the bargain; and, as a consequence, to equalize the benefits of the trade.

**Co-operative Production.**—Not only can farmers get better prices for the same product by selling in large quantities, but they can also produce, by working together, products that are worth much more. For example, if several farmers are raising horses they can get better prices for them if they all raise horses of the same type and breed. It is easier in such a case for a purchaser to get a matched team, and where several horses can be bought in one neighborhood, a buyer can

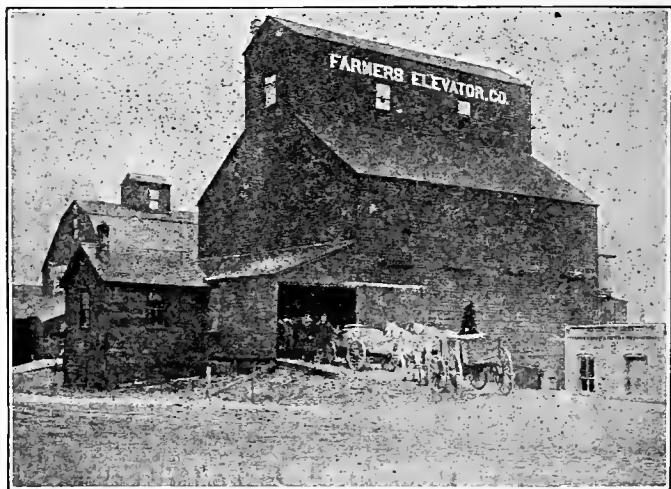


Fig. 124.—A Farmers' Co-operative Elevator. This represents an industry that in many localities has saved farmers thousands of dollars.

afford to pay a better price for them than he could if he had to search several neighborhoods, because he is saved the time and expense of searching.

There are great possibilities for farmers to materially benefit themselves by closer co-operation in many of their farming and business enterprises. Several farmers working together greatly increase their own strength and resources, and better equip themselves to meet con-

ditions as they exist at the present time. They can produce large quantities of superior and uniform products, and put them on the market in such condition and quantity as to assure top prices.

**Questions:**

1. What do you understand "co-operation" to mean?

2. Where is the best example of co-operation to be found?

3. What is one great obstacle to co-operation among farmers?

4. Why does a farmer trading with a large concern often get the worst of the bargain?

5. Why are a number of farmers, buying or selling together, almost sure to get better prices?

6. Why can a buyer afford to pay more when large and uniform quantities of any one thing can be found in a neighborhood?

**Arithmetic:**

1. Thirty farmers want \$100 worth of machinery each. How many dollars worth of machinery do they all want? How much would they save if they could get 10 per cent. discount? If they could get 20 per cent. discount?

2. A cattle buyer, to get a car load of cattle, spends 3 days, paying \$5.00 per day for livery and \$2.00 per day for hotel accommodations. His time is worth \$5.00 per day. How much does it cost him in time and expense? How much does this expense amount to per head if he buys 18 head?

3. If a car of uniform cattle, weighing 24,000 lbs., sell for 50c per 100 lbs. more than mixed cattle, how much more are they worth than a car of mixed cattle?

**MARKETING BUTTER.**

**Co-operative Creamery.**—One of the best examples of co-operation among farmers, in the Northwest, is the co-operative creamery; and the results should be sufficient to encourage effort along other lines.

Before the introduction of the co-operative creamery, every farm manufactured its own butter. In most cases poor facilities were at hand for the work, and as a consequence a product often not first class, and never uniform, was produced. The result was that butter sold at a very low price, often 6c. to 10c. per pound. Many farmers produced good butter, but very few farms were so situated as to be able to sell their product in such a way as to get a good price for it. Few farms had a constant or uniform supply of butter, and this fact made it impossible for a merchant to work up a trade for the product from a certain farm or of a certain quality, because he could not be sure of getting the butter for any definite length of time. This resulted in merchants in the small towns paying about the same price for all butter, mixing it all together and selling it all at a low price. Consequently they could afford to pay but a low price for it.

**Principles of Marketing.**—There are three conditions which have a tendency to increase the price of a staple product, and as these conditions are well illustrated by our creameries we mention them here.

1st. A large quantity of a desirable product in one place attracts several buyers, thus increasing competition and the price. 2d. A uniformly good product and a constant supply enables a dealer to build up a demand for something good; hence he can pay a better price for it. 3d. Bringing the buyer to the product, instead of sending the product to the buyer, tends to increase the price, because it enables the seller to refuse the price offered and wait for a better offer, which he cannot always do if he has delivered his product.

The average co-operative creamery produces from \$20,000 to \$50,000 worth of butter in a year. This naturally attracts buyers who are anxious to handle the large product. Creameries turn out a fairly uniform quality of butter, which has been a very strong factor in increasing the demand and the price for creamery

butter. On account of the large and uniform product, buyers come or send to the creamery, consequently the creamery manager can sell or hold the product in the refrigerator until he gets the offer he considers fair. These same principles hold true in the marketing of any farm product.

**Why Some Creameries Fail.**—That a well managed and well patronized co-operative creamery can compete successfully with any other known plant, in the manufacture of butter, has been amply proved. Still there are now many creameries that are being injured, and a few of them closed, by the competition of the large



Fig. 125.—A farmers' co-operative creamery where a large quantity of a uniform product is produced and offered for sale in an attractive and business-like manner. Farmers of the Northwest should be proud of their success with this form of co-operative factory.

privately owned creameries called "centralizers." These "centralizers" have their cream shipped from any place they can get it. In order to get cream where there is a local creamery, they may offer a better price than the local creamery can pay, or they may get cream at the same price from a few of its dissatisfied patrons.

Losing any considerable amount of cream greatly weakens the local plant, and it cannot pay as much for butter-fat as it had been paying, because the butter maker's salary and other expenses must be paid out of

a smaller output. This forces the local plant to run at a loss or close.

**Stand by Local Creamery.**—The closing of the local creamery would not be so undesirable if the centralizers continued to pay good prices for cream; but they cannot as a rule continue to pay as good prices as can a well managed and well patronized co-operative plant, because they have difficulty in getting cream of as good quality as does the co-operative creamery, and consequently cannot make as uniformly good butter.

It generally happens that when the local creamery is closed, the centralizer, being relieved of competition, reduces the price paid for cream below that paid by the best co-operative plants.

For their own interests as well as the interests of the community, it pays patrons of a co-operative creamery to stand by their own plant and not be lured away by temporary high prices, or high tests, or by jealousy and spite; for the chances are that as soon as the local creamery is closed they will get less for butter-fat than their own creamery can pay them if they patronize it.

### Questions:

1. What was the cause of the low price formerly paid for butter?
2. Give the three principles of successful marketing.
3. What is often the reason of a co-operative creamery failing?

### Arithmetic:

1. If a farmer keeps 12 cows and each produces  $\frac{1}{2}$  lb. of butter-fat per day, how many pounds of butter-fat will he get per week? How many pounds of 25% cream will he get per week? (1 lb. of butter-fat will make 4 pounds of 25% cream.)
2. How much should a farmer receive if he sells 168 pounds of 25% cream at 30c. per pound for butter-fat?
3. How much less would he receive per week for his 168 pounds of cream if he were paid but 27c. per



pound for butter-fat? If he lost \$1.26 per week, how much would he lose in 1 year?

4. How much less would he receive if he were paid 30c. per pound, but his 168 pounds of cream tested but 22% butter-fat? If he lost \$1.51 per week, how much would he lose per year?

#### MARKETING EGGS.

**Fresh Eggs Scarce in Cities.**—It is no easy matter for people in town to secure good, fresh eggs whenever they want them. There are thousands of people in every large city who are willing to pay good, and even fancy prices, for eggs, if they can be sure of getting a strictly first-class article.

**How Eggs are Marketed.**—The common way of handling eggs is about as follows: Eggs are gathered at

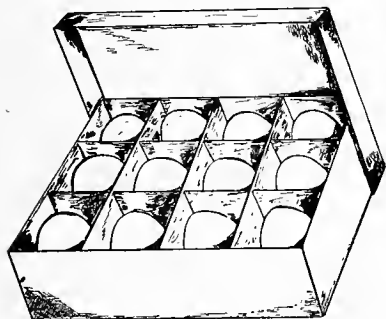


Fig. 126.—A Carton of Eggs. A neat, attractive and convenient way to handle eggs.

irregular intervals, then about once a week they are taken to town and sold or traded to a grocer, who pays one price for all kinds of eggs—white, brown, small, large, dirty or clean—and mixes them all together. Some of these eggs are one day old and some are two weeks or more old. The merchant sets them in his

store room with ill-smelling materials, as meats, oils, etc., and some of these odors are absorbed by the eggs. This mixed case, with other similar cases, is then sent to a commission merchant, who may sell them to a city grocer at once or store them. After more or less delay these eggs are offered for sale to city people. They are often of questionable quality, and it is little wonder that the particular housekeeper hesitates to buy them.

**One Man's Experience.**—A poultry man living near Minneapolis, Minn., sells all his eggs to a certain grocer. The eggs are gathered every day and the date stamped on each egg. Eggs of uniform size and color are put in small cartons or paper cases, holding one dozen each. The cartons are sealed with a label on which is printed a statement that the eggs are guaranteed to be strictly fresh, and if any bad eggs are found the producer will replace them with good eggs. These eggs are marketed every day, and sell readily at 35c. per dozen, when eggs marketed in the ordinary way are selling at 18 to 20 cents per dozen.

**The Farmer's Problem.**—Merchants who buy, handle and sell eggs are not to blame for the low price. It is the lack of uniformity, the unattractive appearance, and the suspicion that the eggs may not be fresh, that causes the low price. The farmer with a small flock of chickens can do very little to improve his markets alone, as he does not produce enough eggs to enable him to interest a grocer or to work up a special trade. The problem, like that of the creamery, seems to require co-operation.

**The Barnum Plan.**—At Barnum, Minn., eggs are marketed through the local creamery. Each patron having eggs to sell is supplied with a rubber stamp, with which he stamps on each egg the name of the Barnum Creamery and his own number, so that in case the eggs are not good they can be traced back to the right farm. Each patron is given as many cartons as he can handle, and he delivers his eggs to the creamery when he does his cream. Any one selling eggs through this creamery must gather them every day, keep them in a cool, clean place, deliver no dirty eggs or eggs more than a week old. In this way the creamery company can guarantee the eggs to be fresh, clean and attractive. They have been shipping eggs in this way for a year or more, direct to high-class grocers in Duluth, who are glad to handle a high-class article. They have been able to pay their patrons from four to ten cents per dozen more

than farmers are getting where eggs are marketed in the old way.

**Suggestions.**—A co-operative creamery is an excellent center at which to deliver eggs, where several farmers are interested.

The young people in a community can get some very valuable experience, and make considerable money, by taking the matter up and marketing eggs as is done through the Barnum Creamery.

When a hen lays an egg in a clean nest it is a clean egg. The next hen coming to the nest to lay may get the first egg dirty. Gather eggs often to avoid this difficulty.

THIS PACKAGE CONTAINS

**One Dozen Guaranteed Fresh Eggs**

**BARNUM CREAMERY CO.**

Manufacturers and Dealers

**Eggs, Butter, Pasteurized Cream and Ice Cream**

**BARNUM, MINNESOTA**

NOTE—Eggs in this package, if they have our trade mark on them, are guaranteed to be strictly fresh, clean and full size, and if ever found otherwise, we wish you would do us the favor to report it, giving number found on the egg.

**BARNUM CREAMERY CO.**

Fig. 127.—The guarantee placed on each carton of eggs sold by the Barnum Creamery Co.

Grade eggs by size and color, and put in neat, clean cartons. Ship in good, strong cases direct to some good merchant in the nearest large city. Get enough people interested, so several cases can be shipped each time, and ship at least twice a week.

Get all producers interested in some one good breed of chickens. Then eggs will be uniform and look more attractive.

### Questions:

1. What can you say regarding the usual method of marketing eggs?

2. Why is the Barnum plan, suggested above, better than the old method?

3. In what way may the people of a community market their eggs to get better results than by selling them to the local grocer?

**Arithmetic:**

1. If each farm produces 30 eggs per day, how many farms would be required to produce enough eggs each day to fill a 30 doz. case?

2. How many farms, producing 30 eggs each per day, would be required to produce enough eggs, so that five cases, holding 30 doz. each, could be shipped three times a week?

3. If each farm produces 30 eggs per day, what would be the gain per day on each farm if 5c. extra per doz. could be secured? If the extra trouble in keeping the eggs clean and neatly packing them takes 15 minutes each day, what rate per hour would a boy make for doing this work?

# INDEX

- Accounts, garden, 285; livestock, 160; with a cow, 163; dairy product, 166; farm, 157
- Acreage, 148
- Aerate soil, 92
- Air, effect of insufficient, 278; for seed germination, 20; for seeds, 13; movement for ventilation, 281; plant food in, 7; pressure, 279
- Annual weeds, 52; eradication of, 58
- Apples, adaptability, 303; cultivation of, 305; mulching, 305; preparation of soil, 304; preserving, 307; pruning, 306; setting, 305; soil for, 303; trees, 304; varieties, 303;
- Appropriations for roads, 31
- Babcock test for milk, 185
- Bacteria, explained, 273, in clover roots, 126; in home, 273, 276; multiplication of, 308
- Barley, 23
- Barnum plan for marketing eggs, 331
- Breeds, poultry, 247
- Biennial weeds, 61; eradication of, 62
- Bromus, 70
- Bookkeeping, 157
- Buildings, for live stock, 182
- Bull thistle, 61
- Burdock, 61
- Butter, making, 166
- Canada thistle, 66
- Canning, fruit, 309
- Carbohydrates, 196
- Carbon dioxide, 7
- Check rows, 95
- Chickens, (see poultry)
- Chicks, 249
- Cholera, hog; 233; preventive measures, 234
- Chores, 179
- Cleanliness, in poultry houses, 253
- Climatic conditions, effect of, on corn, 77
- Clover, a clover catch, 125; adds nitrogen to soil, 128; Alsike, 124; for rotation, 154; mammoth, 123; medium red, 123; roots and bacteria, 126, 127; sod, 116; white, 125
- Cock covers, 131
- Cockle, 44
- Co-operation, advantages, 234; co-operative creamery, 326; co-operative production, 325; in marketing, 169; meaning of, 323; need of, 324; obstacles, 324; reduction of cost by, 169; with creamery, 170
- Contest, judging, 37; plan of, 35; plowing, 35; prizes, 36
- Conveniences, 184
- Corn, aerate soil, 92; cultivation of, 90, 93, 94; culture, 87; effect of climatic conditions on, 77; food material from, 83; for rotation, 156; grade seed, 87; crop, 76, 153; growth, 84; kernels of, 79, 80, 82, 100; planting, 89, 95; seed, 81, 82; selection of, 96, 97, 101, 103; shapes, 78, 99; storing seed, 101, 102, 104, 105; testing, 8, 41, 85; varieties, 97, 98; weeds among, 91; yield, 76

- Cows, account with, 163; culling, 188; expense and profits of, 165; feed requirements, 164, 200; maintenance, 200; nutrients required, 201; possibilities of the dairy cow, 192; succulent food for dairy, 208; testing, 188; water for, 181; yields, 193
- Culling, 188
- Cultivation, 118; apples, 305; blind, 118; corn, 90, 93, 94; crops that require, 139; depth of, 93; for currants, 301; for potatoes, 118; for raspberries, 299; for strawberries, 296; to add moisture to the soil, 20
- Cultivators, corn, 94; surface, 94
- Curing hay, 130; time to cut, 131; weather for, 129
- Currants, cultivation, propagation, pruning, 301; setting, soil varieties for, winter protection, 301
- Cream, 168
- Creamery, co-operative, 326; marketing, 327; why some fail, 328
- Creep, A, 239
- Crops, classification of field, 137; cultivated, 139, 145; grain, 137; grass, 139
- Dairying, marketing dairy products, 166; possibilities of, 194
- Dead furrows, 34
- Decomposition, vegetable matter, 12, 142
- Drills, 95
- Dock, curled, 65
- Dragging roads, 320
- Drags, 320
- Drainage, roads, 318; about the home, 272
- Drying corn, 103
- Eggs, cooking, 259, 260; experiences, 331; food value of, 258; how to market, 330; in winter, 261; scarcity, 330; suggestions, 332; the Barnum plan, 331; their uses, 257
- Embryo, 82
- Ensilage, rations containing, 211
- Enterprises, 158
- Ewes, 230; breeding, 229
- Exercise, for livestock, 181; hens, 262
- Experiment, in planting seed at different depths, 24
- Fallow, bare, 73
- Farm accounts, 157; bookkeeping, 157; cost reduction, 169; dairy products, 166-168; enterprises, 158; farmer as a merchant, 159; land rent, 159; livestock, 160-163; the cow, 163-165
- Farms, acreage and yields, 148; arrangement of fields, 149; farmstead, 147; fencing, 148-150; fields for rotation, 149; planning, 146, 152; shape of fields, 147; selection, 146; waste land, 148; worn out, 143
- Farm home, bacteria in, 273; chickens for, 273; cleanliness in, 276; drainage, 272; facilities for, 267; flies, 273; lawns, 268; neatness, 267; planning, 271; sanitation in, 272; shade trees, 269; surroundings, 267; ventilation, 278; windbreaks, 270

Farm management, 133

Farmstead, the, 147

Fat, 196

Feed, classes of 97; comparison of, 199; composition of, 197 and 210; compound ration for, 203; proportion of grain and roughage, 203; for dairy cows, 200; for livestock, 162; roughage, 200; maintenance, 200; nutrients required in, 201; for sheep, 228, 229

Feeding animals, food requirements, 195; horses, 216-223; pigs, 239; poultry, 260; rations, 195, 203, 205; roots, 209; sheep, 228; succulent food for dairy cows, 208

Feeding stuffs, 217, 242

Fencing, 148-150; building, 175; cement posts, 173; corner posts, 175; cost of, 177; economy in, 150; for pigs, 240; for sheep, 228; good workmanship in, 175; investments in, 174; kind of posts, 172; setting posts, 176; stretching, 176; wire, 176

Field crops, classification of, 137

Fields, arrangement of, 149; distance from farmstead, fencing, 150; for rotation, shape, size, 149

Flies, 273

Flues, 282

Food material from corn, 83

Fruit, advantages, 291; apples, 303; conditions of, 308; dietaries, 290; gooseberries, 302; in diet, 289; need of, 290; preparation for, 308; preserving, 307; raspberries, 297; strawberries, 292; succulent food, 289, supply of, 291

Garden, account, 285; arrangement of, 287; income from, 284; value of, 283; location of, 286; plan of, 286; preparation for, 286; size of, 286; soil for, 286

Germination, 43; air and heat for, 20; moisture for, 20; why seeds fail, 14

Germes, seed, 100

Gooseberries, 302

Grading, seed grain, 42

Grafting apple trees, 304

Grape juice, 310

Grain crops, 137; for rotation, 154

Grass crops, 139

Hay, a cleaning crop, 46; cock covers for, 131; clover, 123; crop advantages, cost, 120; curing, 129, 130; damage to by hot sun, 131; time to cut, 129

Headland, 33

Healthfulness in farm homes, 272, 275

Heat, 13; for seed germination, 20

Hogging crops, 244

Horse, change of feed for, 222; corn and clover ration, 224; cost of labor, 214; distribution of horse labor, 215; feeding, 216; feeding and maintaining idle, 223; labor, 5; raising, 215; rations for, 221, requirements of, 220

Hydrogen, 7

Interests on investment, in cow, 164; in farm, 161

Investments, 161; depreciation of, 159

Insects destroyed by plowing, 27

- Kernels, comparison of, 80; examination of, 82; shapes of, 78  
 Kinghead, 44  
  
 Labor, cost of, 214; horse, 214  
 Lands, plowing in, 33; rent of, 159  
 Lawns, 268  
 Lice, 262  
 Light, for livestock, 183  
 Livestock, accounts, 160; care of, chores, value of time, 179, 180; comfort of, 181; conveniences for, cost, 184; depreciation of, 160; exercise for, 181; interest on investments in, 161; light, ventilation for, 183; shelter, 182; water for, 181  
  
 Manure, to smother weeds, 72  
 Marketing butter, 326; co-operation in, 169; principles of, 327; why some creameries fail, 328; dairy products, 166; eggs, 330; explained, 330, 331  
 Meadow for rotation, 155  
 Milk, advantages of weighing, 190; Babcock test, 185; milk test explained, 187; principle of the test, 186; sampling, 191; selling, 168; testing, 185-191; weighing, 189; whole, 168; work for boys, 191  
 Milking, 180  
 Mites, 262  
 Moisture, for seeds, 13; for seed germination, 20; in corn, 90  
 Molds, 308  
 Morning glory, 66  
 Muhlenbergia, 70  
 Mulching, apples, 305; surface, 90  
 Mustard, 52; seeds, 47  
  
 Neatness of farm homes, 267  
 Neglect, in selecting seed, 96  
 Nests, 256  
 Nutrients, 201  
  
 Oats for rotation, 153  
 Oxygen, 7  
  
 Pasture, for pigs, 240; in rotation, 156  
 Pectin, 308  
 Perennial weeds, 64, 71  
 Pigeon grass, 52; seeds, 47  
 Pigweed, 49  
 Plans, for poultry house, 254  
 Plant food, 7; available, 15, 140; air, heat, and moisture in, 13, 141; in air, 7, 141; in soil, 8; made soluble, 10, 141; sources of, 7; insoluble, 140; vegetable matter in, 12, 141  
 Planting, corn, 89; potatoes, 116; seed bed, 22  
 Plow, the, 32; conditions of, 33  
 Plowing, art of, 31; condition of soil, 28; contests in, 35, 36; fall feed, 30; team for, 32; the field, 33; time for, 28, 30; to destroy insects, 27; to judge, 37; objects of, 26  
 Posts, cement, 173; corner, 175; fence, 172  
 Potato, crop, 107, 153; cost, 107; in rotation, 153; planting, 116-118; preparation for crop, 114-116; result of cooking, 111-113; scab, 115; seed, 114, 116; soil, 109; undesirable features, 108; varieties, 110  
 Pork production, 232  
 Poultry, a start with, 247; breeds, 247; care, 248; cleanliness, 253; general principles, 251; houses, 251; importance of, 246; light, 252, on the farm, 246; records of, 246; setting hens, 248; size, 252, ventilation, 253, warmth, 253; winter hens, 250; young chicks, 249  
 Eggs, their uses, 257; value for cooking 258-259



- Winter hens, eggs in winter, 261; exercise, 262; feeding laying hens, 260, 265; mites, 262; no rules, 261; small things, 263; too fat, 262  
 Preserving fruit, 307; canning, 309; molds and bacteria, 308; preparation, 308  
 Propagation, currants, 301; gooseberries, 302; raspberries, 298  
 Protein, 196  
 Pruning, apples, 306; currants, 301; gooseberries, 302; raspberries, 299  
  
 Quack grass, 67  
  
 Ragweed, 44  
 Raspberries, adaptability, 297; cultivation, 299; preparation, propagating, 298 pruning, 299; setting, 298; soil, 297; varieties, 297; winter protection, 300  
 Rations, containing ensilage, 211; containing succulent food, 210; feeding, 205; figuring, 206, 221; for breeding ewes, 230; for laying hens, 264; good, 207; how to feed, 231; poor, 206; to compound, 203  
 Records, poultry, 246  
 Rent, 159  
 Roads, appearance, 313; appropriations, 316; cash tax, 314; construction, 317; cost, 312; dragging, 321; drags, 320; drainage, 318; dirt, 318; importance of, 311; maintenance of, 320; object of, 317; poll-tax, 314; use, 312; repairing, 320; routes, 313; sand, 322; stone, 317; systems for, 314; turnpike, 318  
  
 Roosts, 255  
 Roots, 203, 209; clover, 126, 127; corn, 93  
 Root stalks, 67  
 Rotation, application of, 152; effect on soil, 136; fields for, 149; five year, 154, 155; maintains vegetable matter, 143; of crops, 135; pasture and corn, 156; a practical, 152; rearrangement for, 154; systematic, 135; various, 153, 154.  
 Roughage, 200; for food, 217  
 Rye grass, 69  
  
 Sanitation, of home, 272, 275  
 Scab, potato, 115  
 Seed corn, selection, 98; to remove weed from, 41  
 Seeds, depth to plant, 23; experiments with, 24; farm, 38; favorable and unfavorable conditions for, 15; germinating, 14, 120; observations of, 17; parts of 38; planting, 22; potato, 110, 114; poor, 41; requirements, 13; seed bed, 16, 19, 21; selection of, 39, 41; tests, 38; what they contain, 13; soil for, 18; yields of, 19  
 Shade trees, 269  
 Sheep, breeding, 229, 230; fencing and feeding, 228, 231; little labor required, 227; living on waste products, 226; management, 229; place on the farm, 226; shelter, 227; winter care, 227  
 Shelter, for livestock, 182; cost of, 184; kind of, 182; for sheep, 227; for swine, 236

- Soil, aerate, 92; for apples, 303; clover adds nitrogen to, 128; condition of, 18, 28; effect of potatoes on, 109; effect of rotation on, 136; light, sandy, 18; mellow, 26; moisture in, 9; plant food in, 8; preparation of, 116; for raspberries, 297; for strawberries, 293; varieties, for currants, 301
- Sow, the brood, 235; care, 236; feeding, 236, 237; shelter for, 236
- Growing pigs, a creep for, 239; care of, 238; clean feed, for, 239; fencing for, 240; mother's milk, 238; pasture for, 240; requirements of, 238; summer feed for, 239; weaning, 240
- Hogs, arrangement of fields, comfort of, 244; corn for, 243; early fall feed for, 242; fattening economically, 241; field peas for, 242; labor, 242; waste by hogging crops, 243
- Sow thistle, 66
- Split, log drag, 318, 320
- Spraying, weed, 53; machines, 53
- Starch, 7
- Storing seed corn, 104
- Strawberries, adaptability, 292; cultivation, 296; planting, 295; plants, 294; preparation for, 293; setting, 295; soil for, 293; varieties of, 292
- Succulent food, for dairy cows, 208; rations containing, 210
- Sweet vernal, 69
- Swine, advantages of, 232; cholera among, 233; disadvantages of, 233; pork production, 232
- Syrup, for canning, 309
- Tar paper, for killing weeds, 71
- Taxes, cash, 314; poll, 314
- Team for plowing, 32
- Testing, corn, 85; cows, 188; good seed, 38; milk, 185, 197; principles of, 186; seed corn for germination, 84
- Thistles, compared, 62
- Tillage, 26; reason for, 16
- Varieties of apples, 303; of corn, 97; of soil, 301; of weeds, 51
- Vegetable matter, decomposition of, 12, 142
- Ventilation, expansion, 280; for live stock, 183; for poultry house, 253; flues, for 282; movement of, 281; object of, 282; physics of, 280; simplicity, 280; supply of 282
- Vetch, 45
- Warmth, for poultry, 253; for seed germination, 20; for live-stock, 181
- Waste land, 148
- Weaning, pigs, 240
- Weed seeds, 41, 43, 44, 46, 47
- Weeds, annual, 52-55; biennial, 61; classes of 51; losses caused by, 43; perennial, 64, 67; specimens of, 50; spraying, 53; eradication of, 49, 58, 62, 71, 73
- Weighing milk, 189
- Wild oats, wild barley, wild buckwheat, 55
- Windbreaks, kinds, 270; value, 270
- Yeast, 307
- Yields, 148, 191; increased cow, 193; of corn, 76

# Agricultural Text Books for High Schools

The four agricultural books described below are planned especially for High Schools in which agriculture is taught. They constitute a complete four year graded course. Each book is complete in itself and is prepared to cover the subject as thoroughly as the time allotted to agriculture in one year will permit.

They are thoroughly practical; they discuss subjects in their logical order, contain laboratory exercises and experimental work, and a list of questions after each chapter to emphasize the important features of each lesson. These books constitute a complete, concise and practical course that will meet the urgent need of the modern agricultural High School.

**FIELD CROPS**, by A. D. Wilson, Superintendent of Extension and Farmers' Institutes, Minnesota College of Agriculture; and C. W. Warburton, Agronomist, Bureau of Plant Industry, U. S. Department of Agriculture. An intensely practical discussion of the American farm crops is presented in this volume, which abounds in helpful suggestions and valuable information for the most successful growing, harvesting, and marketing of the various crops. It is divided into three parts, containing also two introductory chapters on the classification of crops and the growth of plants.

Part I. Contains seven chapters, discussing in detail all of the Grain Crops.

Part II. Contains twelve chapters, discussing all of the Forage Crops.

Part III. Contains six chapters, discussing fully the Miscellaneous Crops, including: potatoes, sugar crops, fibre crops, tobacco, weeds, rotation, etc.

This is the most complete and authentic book for the purposes on the market. It contains about 450 pages, nearly 200 illustrations, is printed on high grade book paper from clear type and bound in a neat, handsome and durable cloth cover.

Price..... \$1.50 net

**BEGINNINGS IN ANIMAL HUSBANDRY**, by Chas. S. Plumb, Professor of Animal Husbandry, University of Ohio, and Author of "Types and Breeds of Farm Animals," "Indian Corn Culture" and "Animal Husbandry Literature," etc. This is the first volume prepared on the subject of Animal Husbandry that is particularly adapted to the needs of high school students in agriculture. Professor Plumb has long been known as one of the leading instructors and investigators in the Animal Husbandry field, as a judge of live stock, and as a clear thinker and interesting writer on live stock subjects. In this new volume he has concentrated the results of his many years' experience in teaching and experimentation. The matter is presented in a simple, practical manner that makes it particularly valuable for the purpose for which it is intended.

Among the important subjects which are discussed minutely are: Breeds of Horses, Cattle, Sheep and Swine; Animal Type and Its Importance; Reasons and Methods of Judging Live Stock; Points of the Horse; Judging Horses, Cattle, Sheep, Swine, etc.; Heredity: Its Meaning and Influence; Selection and Its Importance; Pedigrees and their Value; Suggestions to Young Breeders; Composition of Plants and Animals; Influence of Foods on Body; Feeding Standards, Origin and Use; How to Calculate a Ration; Coarse Feeds and their Value; Concentrated Feed and their Value; Poultry: Feeding, Management and Marketing; and the General Management of Cattle.

This will be a book of about 350 pages profusely illustrated, well printed, durably bound, Price..... \$1.25 net

**SOILS AND SOIL FERTILITY**, by A. R. Whitson, Professor of Soils, University of Wisconsin; and H. L. Walster, Instructor of Soils, University of Wisconsin. A book especially prepared as a text book on the subject of soils for high school courses in agriculture. Among the most important subjects fully discussed are: Conditions Essential to Plant Growth; Origin of the Soil; Supply of Chemical Elements; Nitrogen, Phosphorus and Potash; Soil Analysis; Manures; Artificial Fertilizers; Physical Properties of Soils and Plant Growth; Moisture; Temperature and Ventilation; Drainage; Erosion; Tillage; Humus; Relation of Crops to Climate and Soils; Rotation of Crops; Classification of Soils; Management; Dry Farming and Irrigation; Selection of Farms. This book does not go into the scientific detail of the structure and chemical composition of soils, but discusses in a simple, practical way the best methods of handling the land to produce good crops. About 300 pages, well illustrated, printed on high grade paper, bound durably in cloth cover. Price..... \$1.25 net

**AGRICULTURAL ENGINEERING**, by J. B. Davidson, Professor of Agricultural Engineering, Iowa State College, and Joint Author of "Farm Machinery and Farm Motors." A practical elementary book on the subjects of Rural Engineering for use in high schools. The fundamental principles of agricultural engineering are presented in a simple practical manner, entirely within the comprehension of the high school student.

Among the subjects discussed are: Agricultural Surveying, Drainage, Irrigation, Road Construction; Farm Machinery, including the relation of Farm Machinery to Farm Operations, Elements of Machines, Material and Lubrication; Tillage Machinery, Seeding Machinery, Harvesting Machinery, Combined Harvester and Thresher, Manure Spreaders, Haying Machinery, Threshing Machinery, Feed Cutters, Huskers and Shredders, Feed Mills, Wagons, Buggies, Sleds, and Pump Machinery; Farm Motors, including Sources of energy, Transformation of energy, Prime Movers, and hand work; Wind mill, Steam Engine, Steam and Gas Tractors and Electric Motors; Farm structures, and Farm Sanitation. This book will contain about 450 pages with many illustrations from photographs and drawings, printed on high grade paper from clear type, and will be handsomely bound in durable cloth covers. Price..... \$1.50 net.

Instructors, teachers and students of agriculture will find these books very helpful, as they contain authentic information on the various subjects discussed, that is given in clear concise language which is easily understood; exercises and experiments follow all lessons. Every effort has been made to make these books interesting, practical and reliable. Send all orders to

**WEBB PUBLISHING COMPANY, ST. PAUL, MINNESOTA.**

# STANDARD AGRICULTURAL BOOKS

Published and Sold By

WEBB PUBLISHING COMPANY,  
ST. PAUL, MINNESOTA

---

## AGRICULTURAL.

**POPULAR FRUIT GROWING**, by Samuel B. Green. This book covers the factors in successful fruit growing, with list of fruits adapted to each state; orchard protection, injurious insects, diseases injurious to fruits, spraying, harvesting, propagation of fruit plants, etc., etc. It is prepared especially for beginners and as a text book for schools and colleges. 300 pages, 120 illustrations. Price, postpaid..\$1.00

**AMATEUR FRUIT GROWING**, by Samuel B. Green, a practical guide to the growing of fruit for home use and the market, written with special reference to a cold climate. Illustrated. 134 pp. Price, 12 mo. .... Paper, 25 cents; cloth, 50 cents.

**VEGETABLE GARDENING**, by Samuel B. Green. 10th edition. A manual on the growing of vegetables for home use and the market, profusely illustrated. 252 pp.

Price, 12 mo. .... Cloth, \$1.00; paper, 50 cents.

**ELEMENTS OF AGRICULTURE**, by J. H. Sheppard and J. C. McDowell, a complete treatise on practical agriculture covering plant and animal breeding, thoroughly illustrated. A complete text book adopted in public and agricultural schools throughout the Northwest. 12 mo., cloth, 100 pp. Price, \$1.00

**GRASSES AND HOW TO GROW THEM**, by Thomas Shaw, covering name and character of all the principal grasses in America; temporary and permanent pastures; methods in making hay, etc. Illustrated, 453 pp.

Price, 12 mo. .... Cloth, \$1.50

**WEEDS AND HOW TO ERADICATE THEM**, by Thomas Shaw, giving the names of the most troublesome weed pests east and west and successful methods of destroying them.

Price, 16 mo., 210 pp. .... Cloth, 50 cents; paper, 25 cents.

**EVERGREENS AND HOW TO GROW THEM**, by C. S. Harrison. A complete guide to selection and growth of evergreens for pleasure and profit, from seed and nursery, to wind-breaks, and hedges. Illustrated, 100 pp.

Price, 12 mo. .... Paper, 25 cents; cloth, postpaid, 50 cents.

## STANDARD AGRICULTURAL BOOKS.

- FARM WIND-BREAKS AND SHELTER BELTS**, by Samuel B. Green. A manual of tree planting for wind-breaks and shelter with description of the most suitable trees hardy enough to stand Northwestern conditions. Practical cultural directions from seed to maturity. Illustrated, 69 pp.  
Price .....Paper, 25 cents.
- HARDWOOD LANDS**, by D. A. Wallace, describes the characteristics of Minnesota and Wisconsin cut-over timber lands heretofore overlooked as suitable for agriculture. Illustrated. Price .....Paper, 25 cents.
- THE GOLD MINE IN THE FRONT YARD**, by C. S. Harrison. A book about flowers, both for ornamentation and commercial culture, written with special reference to Northwestern conditions. Illustrated, 280 pp. Price, 12 mo. ....Cloth, \$1.00

## POULTRY.

- POULTRY MANUAL**, by Franklane L. Sewell and Ida E. Tilson. A safe guide to successful poultry culture in all its branches, fancy and practical; breeding and feeding; diseases and remedies; how to make farm poultry pay, etc., etc. (40th Thousand. Revised Sept. 1, 1908.)  
12mo., 148 pp. Price .....50 cents; paper, 25 cents.
- EGG MONEY, HOW TO INCREASE IT**, by H. A. Nourse. A book of complete and reliable information on the more profitable production of eggs on the city lot, the village acre and the farm. The instruction in this book will make the "209 eggs a year hen" a reality for the intelligent poultryman. 128 pp., completely illustrated. Price, paper, 25 cents.
- POULTRY HOUSES, COOPS AND EQUIPMENTS**, by H. A. Nourse. A book of newest plans for bulding practical, up-to-date poultry houses, with description of coops, fixtures and poultry utensils for the farm or village poultry keeper. Profusely illustrated, 100 pp. Price.....Paper, 25 cents.
- CHICKS: HATCHING AND REARING**, by H. A. Nourse. A manual of dependable instruction in incubating, brooding, housing and developing winners and layers, fattening, killing and marketing broilers and roasting chickens. 126 pp., fully illustrated. Price.....Paper, 25 cents.
- SIMPLE POULTRY REMEDIES**, by competent authors; describes the symptoms of the leading diseases of poultry and tells how they may be cured or prevented by simple methods. This book should be in the hands of every poultry man. 80 pp., fully illustrated. Price, postpaid.....25 cents.
- TURKEYS, DUCKS, AND GEESE**, by H. A. Nourse, latest and most complete and reliable information on breeding, hatching, rearing, fattening, developing, showing, and selling for pleasure or profit. 128 pp., fully illustrated.  
Price, postpaid.....50 cents.

## STANDARD AGRICULTURAL BOOKS

### LIVE STOCK.

**FEEDING AND MANAGEMENT OF LIVE STOCK**, by Thomas Shaw. A series of lectures on the principles covering selection, feeding, breeding, management and marketing of cattle, sheep and swine. 100 pp.

Price, 8 mo. ....Cloth, \$1.00; stiff cover, 50 cents.

**FIVE HUNDRED QUESTIONS ANSWERED ABOUT SWINE**, by L. H. Cooch. This manual is practically a complete veterinary book for swine breeders. Not only does it contain answers to questions concerning diseases of swine, but it also fully and carefully compares the different breeds, treats of breeding, feeding and pasturing. Price, paper, 25 cents.

**THIRTY DAIRY RATIONS**. Thirty complete balanced dairy rations. Treats also of the feeding and care of dairy cows, by H. C. Carpenter. Illustrated. Price, paper, 25 cents.

### MISCELLANEOUS.

**FARM BLACKSMITHING**, a complete treatise on blacksmithing by J. M. Drew, written for farmers who want a workshop where they can profitably spend stormy days. Illustrated, 100 pp. Price, 12 mo. ....Cloth, 50 cents.

**STANDARD BLACKSMITHING, HORSESHOEING AND WAGON MAKING**, by J. G. Holmstrom, author of "Modern Blacksmithing," gives practical instructions by a successful blacksmith. The latest and most complete book on the subject published. Thoroughly Illustrated.

Price, 12 mo. ....Cloth, \$1.00

**THE FARMER'S TANNING GUIDE**, by G. E. Stevens, gives all the quick ways of tanning in from ten minutes to six weeks. Also complete receipts for making your own solutions. Prepared especially for farmers. Price .....Paper, 25 cents.

**VACANT GOVERNMENT LANDS**, locates all available government lands that can be secured free by entry and tells how to get them. All about irrigated lands and how obtained free. (1908 Edition.) 112 pp. Price.....Paper, 25 cents.

**THE DOMINION OF CANADA**, by Moses Folsom. All about free government land in Canada and how to get it. 155 pp. Price, 12 mo. ....Cloth, 50 cents; paper, 25 cents.

**THE COUNTRY KITCHEN**. Nine hundred tried and tested recipes suited to the country and contributed by readers of The Farmer. The most popular and practical cook book on the market. 154 pp.

Price, 12 mo. ....Cloth, 50 cents; paper, 25 cents.

**THE "BUCKEYE" COOK BOOK**, by Mrs. Wilcox. A careful compilation of tried and approved recipes for all branches of the household. 1288 pp. with complete Index.

Price, postpaid .....\$2.50









